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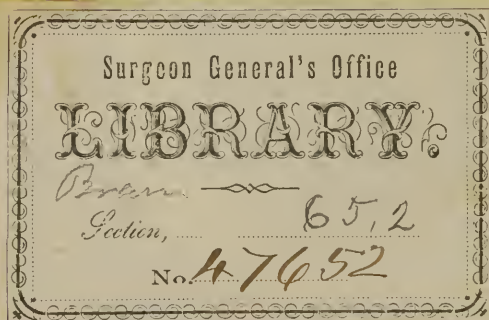
CEREBRAL
CONVOLUTIONS OF MAN

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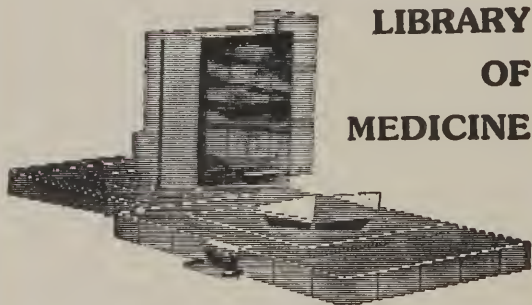
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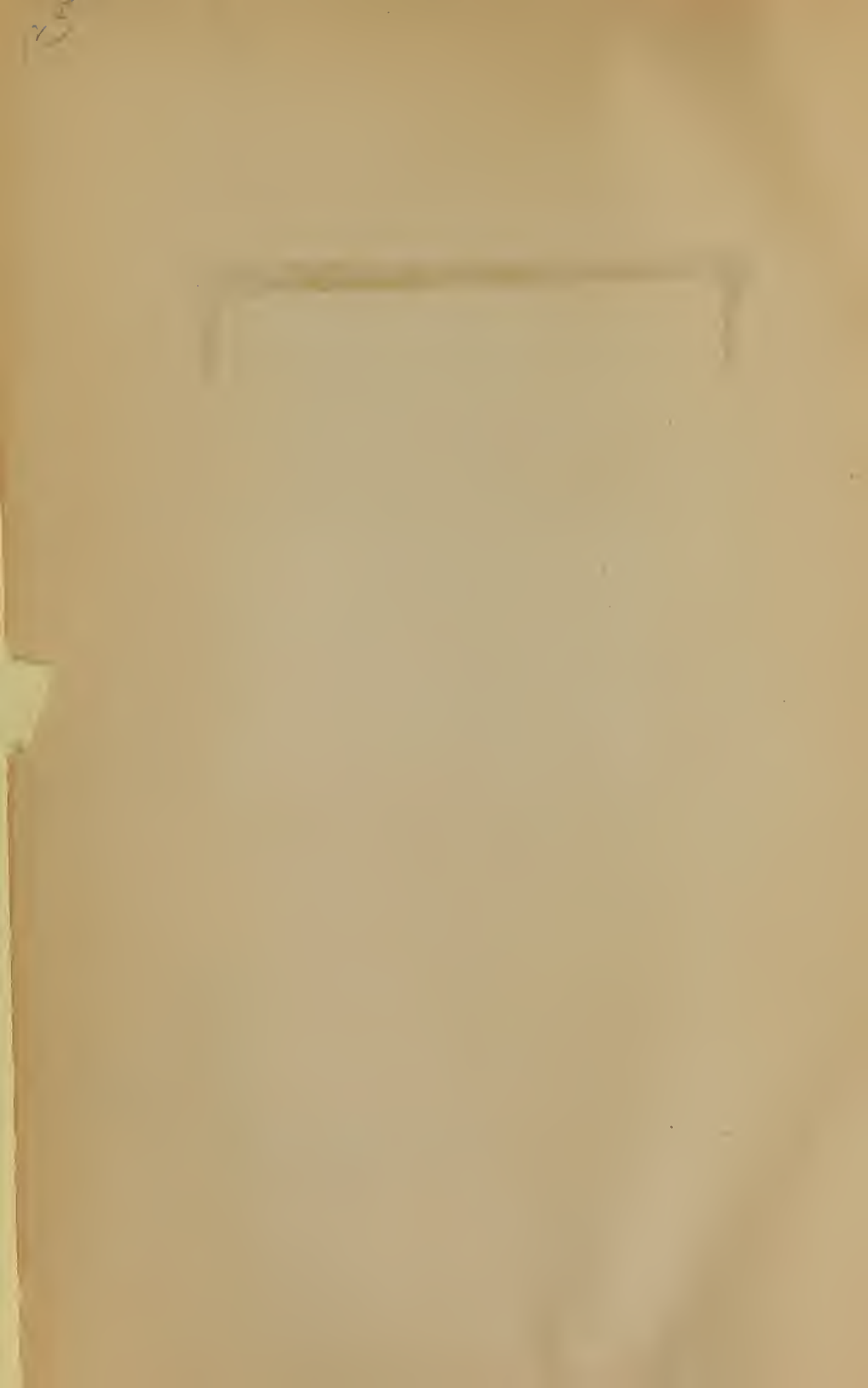


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THE
CEREBRAL CONVOLUTIONS OF MAN,
REPRESENTED
ACCORDING TO ORIGINAL OBSERVATIONS,
ESPECIALLY
UPON THEIR DEVELOPMENT IN THE FŒTUS.

INTENDED FOR THE USE OF PHYSICIANS.

BY
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TRANSLATED BY
ROBERT T. EDES, M. D.

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NEW YORK:
D. APPLETON & COMPANY,
549 & 551 BROADWAY.
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P R E F A C E.

THE great problem of an organology of the cerebral surface, that is, of an anatomico-physiological knowledge of the psychical brain-organs, rests in great part in the hands of physicians: only by accurate observations of patients, in connection with the most careful autopsies, can we gradually arrive at some knowledge of the physiological meaning of the single convolutions upon the cerebral surface.

There are numerous difficulties which stand in the way of a solution of this problem; not the least of which is that which lies in the study of the convolutions themselves, that is, the difficulty of recognizing the constant unity of form in the multiplicity of the individual variations. In this part of the study it is first of all the duty of anatomists to

place in the hands of practitioners materials which shall make it possible for them to find their way easily in the apparent chaos of convolutions. Only then will they be able to record correctly the observations made on the cadaver.

The anatomists are not entirely disinterested in performing this service for the practitioners, since they expect in return material from which the hoped-for science may some time arise.

For this object it has long been my intention to give a summary description of the cerebral convolutions for the use of physicians, and I think that its fulfilment has not been made superfluous by the later excellent works on this subject. The following description, which rests throughout on my own investigations, is especially supported by the study of the development of the cerebral convolutions in the foetus, the result of which will be more completely reported in another place. The accompanying figures are to be regarded not so much as pictures, as maps by which one may be placed in a position to find his way more easily in this region.

ALEXANDER ECKER.

FREIBURG, *March*, 1869.

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THE CONVOLUTIONS OF THE BRAIN.

INTRODUCTION.

THAT the cortex of the cerebrum, the undoubted material substratum of our intellectual activity, is not a single organ which enters into action as a whole with every psychical function, but consists rather of a multitude of organs, each of which subserves definite intellectual processes, is a view which presents itself to us almost with the force of an axiom. The opposite hypothesis of a single organ for the multiplicity of the intellectual functions would mark a stand-point about equally advanced with the abandoned conception of a "Vital Force." If, however, as we think is undoubtedly true, definite portions of the cerebral cortex subserve definite intellectual processes, there is a possibility that we may some day attain a complete organology of the brain-surface, a science of the localization of the cere-

bral functions. Such a science—that is, a knowledge of the psychical organs of the brain in all their relations—is certainly one of the most important problems for the anatomy and physiology of the next century, the solution of which will work no small transformation in psychology. There are many causes why this problem is still almost completely unsolved.

We have undoubtedly been too much discouraged from following this path by the ill success of the first serious attempt at a localization of the mental processes. Though Gall in the beginning followed the right road—that of a careful study of the brain—yet he very soon departed from it, and, starting from the fact which, speaking in general terms, is perfectly correct, that the form of the skull depends on that of the brain, believed that he could replace the laborious and rare examinations of the dead brain by those of the living cranium. Bringing certain bunches or bumps of the cranium into connection with certain mental dispositions, for which purpose he had already in his youth collected materials, he now, with his scholar Spurzheim, made a system of Phrenology in which but little was said about the brain, and which, in this form of a scientific structure, was thoroughly defective.

Hence, as may be supposed, the so-called science

of Phrenology has remained since its beginning at the same point, and has fallen from the hands of earnest inquirers, especially the anatomists and physiologists, who turn away from it with deserved neglect, into those of an entirely different class. The travelling phrenologists who wander around with plaster heads of Schiller, Napoleon, and some celebrated rascals, and cipher out a character from a number of bumps on the skull, are well known. Few of them have ever seen a brain.

It was not alone the reaction from this unsuccessful first attempt, which deterred from a continuation in the path marked out, possibly fruitful in results; but the necessary conditions were wanting. In spite of the certain knowledge that the brain-surface is the organ of the soul, and in spite of the consequent urgent summons to the anatomical study of the cerebral convolutions, this was until very lately much neglected, or rather the clew was wanting to guide one correctly in this labyrinth. The convolutions were considered as a bundle without system, and the artists drew them as they might draw any dishful of *macaroni*. It was at first gradually seen that certain furrows and convolutions are more constant than others; but, so long as attention was confined to the fully-developed human brain, actual progress was not possible. Comparative anat-

omy and the history of development, these lamps of human anatomy, first brought light into this darkness. It was the works of Huschke, and especially of Gratiolet, on the monkey-brain, which proved the harmony in the structural plan of the cerebral convolutions of the apes and those of man, and thus for the first time prepared the way for the understanding of the latter. Yet, any thing is fully understood only through itself, and every completed growth through its own growing; and thus tracing the development of the human convolutions is certainly the way by which alone a correct insight can be gained. This way has already been followed by various inquirers, as Gratiolet, Reichert, and Bischoff, and the following demonstration of the convolutions is throughout founded on the study of their development in the fœtus. This is also the only way to learn the law of formation of the convolutions, that is, the formation of the convolutions as a necessary consequence of certain mechanical processes of the growth of the brain and skull. Up to the present time we are far removed from such a knowledge. At the farthest, the formation of the fossa Sylvii is open to an explanation in this point of view. The relations between the arrangement of the arterial vessels of the brain and that of the convolution, to which Reichert has called atten-

tion, are certainly not without meaning. What Birschhoff¹ says is also perfectly correct, that a large number of the convolutions of the cerebral hemispheres are arranged around the ends of the primary furrows in more or less simple or complicated arches; and it cannot be otherwise, for the ranges of mountains enclosing a valley must necessarily pass into each other where the valley ends, but no special explanation seems to be thereby disclosed.

If we consider the arrangement of the convolutions in general, there may be distinguished first, chief or primary convolutions; then secondary or subordinate convolutions; and, finally, tertiary convolutions.

The chief or primary convolutions or folds are like great mountain-chains whose direction, as it has been correctly expressed, lends to a region its characteristic features. The secondary folds originate by the splitting of a primary convolution into smaller ones by the formation of longitudinal furrows, as secondary mountain-ranges arise from the formation of longitudinal valleys.

The deep furrows which separate the chief convolutions from each other, we may name chief furrows; those which separate the secondary convolutions from each other, secondary furrows; and, finally, the tertiary convolutions are those little

¹ L. c., S. 34.

ranges jutting out into the chief furrows from the valley-sides of the chief convolutions, which, usually engaged between those of the opposite side, give to the bottom of the valley, or of the furrow, a zigzag course. These are usually plainly seen only when the borders of the chief furrows are pulled apart; in brains whose chief convolutions have grown smaller, from senile or other atrophy, with much infiltration of the *pia mater*, they come immediately to light. While the features of the chief convolutions are always arranged with considerable uniformity, numerous variations exist in the extent of the secondary and tertiary convolutions: in the first place, for the reason that sometimes few, sometimes many secondary furrows are formed, and also because in one case hidden tertiary convolutions come to the surface; in another, convolutions which usually are superficial sink deeper. In the first case, furrows are bridged over; in the latter, they exist where there are usually none.

THE FISSURES AND CONVOLUTIONS OF THE CEREBRAL SURFACE.

EACH hemisphere of the cerebrum, as is well known, may be incompletely divided, by more or less deep indentations, into several divisions or lobes, which were first more accurately distinguished by Burdach¹ as anterior lobe, *lobus anterior*, upper lobe, *lobus superior*, with the cover (*operculum*), lower lobe, *lobus inferior*, and trunk-lobe, *lobus caudicis*. Arnold has proposed, instead of these names, others derived from the principal surrounding bones, and these latter designations are those now commonly used. Thus, we now distinguish the frontal lobe, *lobus frontalis*, parietal lobe, *lobus parietalis*, temporal lobe, *lobus temporalis* (also called sphenoidal lobe, *lobus sphenoidalis*, or temporo-sphenoidal, *lobus*

¹ L. c., Bd. II., S. 169, *et seq.*

temporo-sphenoidalis), and occipital lobe, *lobus occipitalis*.

The trunk-lobe of Burdach, not standing in immediate relation with the skull, is distinguished either by this name, or as the island (of Reil), intermediate or concealed lobe, *lobus intermedius*, s. *operatus* (Arnold), or as central lobe, *lobus centralis* (Gratiolet). The demarcation of the single lobes from each other is only clear on certain surfaces; on the others they pass into each other without distinct boundaries. I shall, in the following pages, first consider the chief fissures by which the single lobes are separated from each other, then the single lobes in order, and in these again the fissures to be recognized upon them, and the lobules and convolutions bounded and formed thereby.

The fissures are always the most important part, and are hence the point whence the description takes its departure. This shows most clearly the development of the cerebral surface in the fœtus. Here three primary fissures, first of all, divide it off into a number of districts. Actual convolutions are formed in these districts only with the further progress of the formation of fissures. The most important separating fissures are the following:

I. PRIMARY FISSURES.

1. FISSURA s. FOSSA SYLVII (*S*).

This important cleft, by which one of the principal divisions of the hemispheres is brought about, is not to be placed in the same category with the remaining fissures of the cerebral surface. The latter originate simply from depressions or folds of the cerebral cortex at a comparatively late period of fœtal life—the former appears as early as the third month, and in an entirely different way; that is, by the whole hemisphere curving itself in an arch, concave below, around the place of entrance of the cerebral peduncle.¹

The *fissura Sylvii* begins at the base of the brain behind the origin of the olfactory nerves, laterally from the *chiasma nervorum opticorum*, in the

¹ By this curve a shallow open trench, the *fossa Sylvii*, is formed on the lower surface of each hemisphere, which is thereby divided into an anterior and posterior portion. Since this trench runs from the lower surface to the lateral, first upward and then upward and backward, it separates the frontal and parietal from the temporal lobe. Later (in the sixth month) the oval trench is changed by the formation of the anterior upright branch into a triangular one; and, since now the lobes, frontal, parietal, and temporal, with their opposite borders, the first with its posterior, the second with its inferior, and the third with its superior, pressing toward a common centre, grow to meet each other, the bottom of the trench, formed by the "island," is gradually covered, and the originally wide-open pit, the *fossa Sylvii*, is changed into a narrow cleft, the *fissura Sylvii*.

anterior perforated space, runs thence outward, gradually narrowing, and thus arrives at the arched lateral surface of the hemisphere. Here it immediately divides into two branches — an anterior shorter, steeply ascending, which is directed forward toward the frontal lobe, *Ramus ascendens* s. *anterior* (S''), and a posterior much longer, *Ramus posterior* s. *horizontalis* (S'), Fig. 1, which is directed toward the posterior portion of the parietal lobe. The upper ends of both branches are sometimes simple, sometimes radiating into several secondary fissures, and are surrounded by arched convolutions.

Between these two branches hangs down the “cover,” *operculum*, which is formed especially by the lower ends of the two central convolutions as they pass into each other, and by a small portion of the lower frontal convolution, and lower parietal lobule. It covers the “island” from above. It fits into the angle of the Y which is formed by the divergence of the two branches of the *fossa Sylvii*.

2. SULCUS CENTRALIS. *Central furrow.* HUSCHKE (*c*).

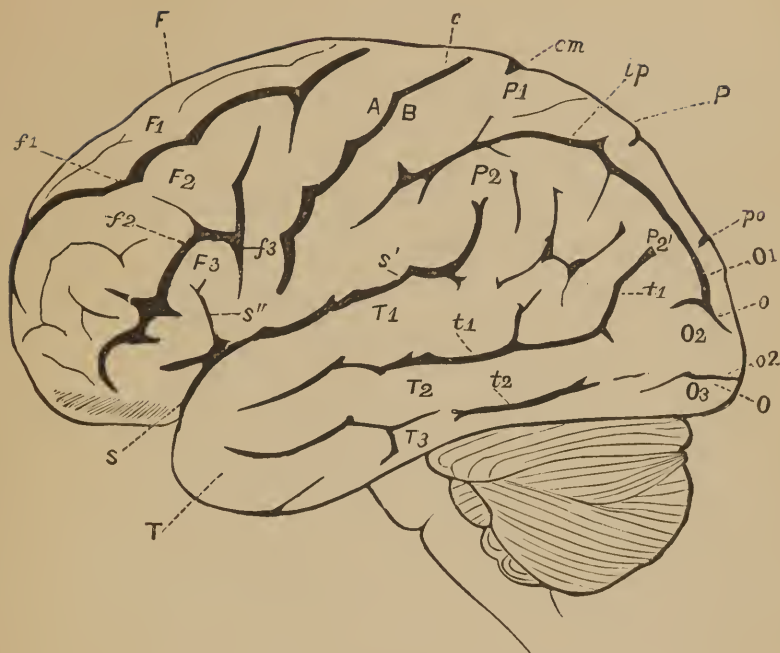
Scissure de Rolando. LEURET.

Fissura transversa anterior. PANSCH.

Postero parietal sulcus. HUXLEY.

This fissure, which, though earlier mentioned, was first accurately described by Rolando, is, without ex-

FIG. 1.



VIEW OF THE BRAIN FROM THE SIDE.

F Frontal lobe; *P* parietal lobe; *O* occipital lobe; *T* temporal lobe.

S Fissura Sylvii; *S'* horizontal, *S''* ascending branch.

c Sulcus centralis; *A* anterior, *B* posterior central convolution.

*F*₁ Upper, *F*₂ middle, *F*₃ lower (or third) frontal convolution.

*f*₁ Upper, *f*₂ lower, *f*₃ vertical frontal fissure (sulcus præcentralis).

*P*₁ Upper, *P*₂ lower parietal lobule; *P*₂ gyrus supramarginalis, *P*₂' gyrus angularis.

ip Sulcus interparietalis.

cm End of the sulcus calloso-marginalis.

*O*₁ First, *O*₂ second, *O*₃ third, occipital convolution.

po Fissura parieto-occipitalis.

o Sulcus occipitalis transversus.

*o*₂ Sulcus occipitalis longitudinalis inferior.

*T*₁ First, *T*₂ second, *T*₃ third temporal convolution.

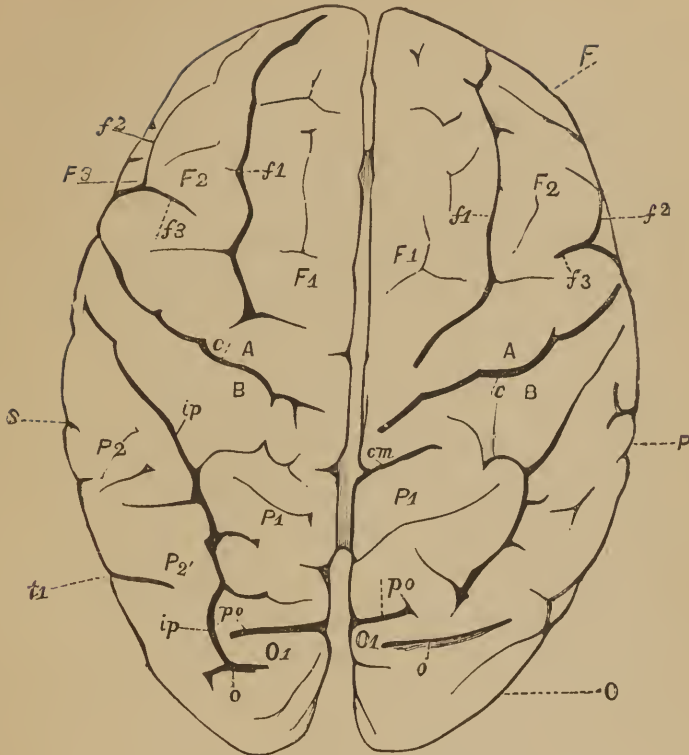
*t*₁ First, *t*₂ second temporal fissure.

ception, present in the human brain, is characteristic of this as well as those of most apes, and is also, not the first indeed, but one of the first which appears in the foetal brain, since it may be recognized at the end of the fifth month. On account of its very constant presence, and because it is never, or extremely seldom, bridged over in its course by a secondary convolution,¹ it forms the surest point of departure in searching out the convolutions. It begins near the medial border of the hemisphere, and passes thence obliquely forward and downward, to end near the upper border of the posterior branch of the *fissura Sylvii*,² the furrows of the two sides thus forming with each other an angle opening forward. This angle appears to become more acute, and the course of the furrow to run more obliquely backward in proportion as the frontal lobe increases in size, and the brain in general attains a higher development. In fact, the whole position of the fissure under these conditions appears to be thrust farther backward. In its whole length the fissure is bordered by two convolutions, the anterior and posterior central con-

¹ This rare occurrence, which has never been observed either by Turner (l. c., B. 10) or Bischoff (l. c., S. 39), is found in the brain of the physician Fuchs, figured by R. Wagner (l. c., 2 Abhandlung, Taf. I.).

² I have not yet seen a complete opening of the central furrow into the *fissura Sylvii* of which Turner speaks (l. c., p. 12).

FIG. 2.



VIEW OF THE BRAIN FROM ABOVE.

- F* Frontal lobe, *P* parietal lobe, *O* occipital lobe.
*S*₁ End of the horizontal branch of the fissura Sylvii.
c Central fissure; *A* anterior, *B* posterior central convolution.
*F*₁ Upper, *F*₂ middle, *F*₃ lower frontal convolution.
*f*₁ Upper, *f*₂ lower, *f*₃ vertical frontal fissure (sulcus præcentralis).
*P*₁ Upper, *P*₂ lower parietal lobule; *P*₂' gyrus supramarginalis, *P*₂' gyrus angularis.
ip Sulcus interparietalis.
cm Sulcus callosomarginalis.
po Fissura parieto-occipitalis.
*t*₁ Upper temporal fissure.
*O*₁ First occipital convolution.
o Sulcus occipitalis transversus.

volutions (A. B.), Fig. 2, which curve into each other at both ends of the fissure, that is, at the medial border of the hemisphere, and at the upper border of the fissure of Sylvius. This fissure forms a natural boundary between the frontal and parietal lobes upon the upper surface of the hemisphere, and I therefore consider the anterior central convolution as belonging to the frontal lobe, the posterior to the parietal.¹

3. FISSURA PARIETO-OCCIPITALIS (po).

This fissure, which separates the parietal from the occipital lobe, cuts more or less deeply into the hemisphere from its medial border, appears on the upper as well as the medial surface, and, being on this account reckoned among the fissures both of the one and of the other, has received different names in the two places. It is evident that such a separation is inconvenient, and easily gives rise to mistakes; I shall, therefore, consider the whole fissure as one, under the above-mentioned name, but separate it into two parts, a medial and a lateral.

¹ Gratiolet, Bischoff, and others, include the anterior central convolution also, in the parietal lobe. This view seems to me particularly unacceptable for the reason that this convolution stands in close connection with the convolutions of the frontal lobe, but has, on the contrary, scarcely any with those of the parietal.

a. The medial portion, *pars medialis s. verticalis fissuræ parieto-occipitalis*.

SYN.—Fissura posterior, BURDACH (l. c., II., 166, Taf. VII., β . γ .),

ARNOLD (Hirn und Rückenmark, S. 51).

Scissure perpendiculaire interne. GRATIOLET.

Occipito-parietal fissure. HUXLEY.

Fissura occipitalis s. posterior, Senkrechte hintere Hirnspalte.

WAGNER.

Fissura occipitalis interna. PANSCH.

Fissura occipitalis perpendicularis interna. BISCHOFF.

Internal perpendicular fissure. MARSHALL.

This deep and very constant fissure, the first—with the fissura calcarina—which appears in the fœtus (in the fourth or at the beginning of the fifth month) runs in a curve concave forward, from the upper medial border of the hemisphere upon the flat, vertical medial surface forward and downward, and joins the *fissura calcarina* at an acute angle.

It separates, as its name indicates, the parietal lobe, especially the upper medial parietal lobule or præcuneus, from the occipital lobe, especially the cuneus.

b. The upper and lateral portion, *pars superior s. lateralis fissuræ parieto-occipitalis*.

SYN.—Scissure perpendiculaire externe. GRATIOLET.

Occipito-parietal fissure. HUXLEY.

External parieto-occipital fissure. TURNER.

External perpendicular fissure. MARSHALL.

Fissura occipitalis interna. PANSCH.

Fissura occipitalis perpendicularis interna. BISCHOFF.

While the medial portion of the fissura parieto-occipitalis is always uniformly and distinctly developed, this lateral portion is so in very different degrees. This part of the fissure often appears merely as a slight indentation on the upper border of the hemisphere, the meaning of which is manifest only by its connection with the medial portion, at other times the same portion stretches laterally as a transverse fissure over a considerable portion of the hemisphere. The lateral extremity is always bordered by an arched convolution (*gyrus occipitalis primus*, O_1) which passes from the *præcuneus* to the *cuneus*, and is always to be recognized at a very early period in the foetal brain.

II. LOBES OF THE BRAIN.

THEIR FISSURES AND CONVOLUTIONS.

A. FRONTAL LOBE. *Lobus frontalis*.

The frontal lobe forms that portion of the hemisphere situated forward in the cavity of the frontal bone (yet passing beyond the boundary of the coronal suture posteriorly), and resting upon the roof of the orbit. Upon transverse section it is nearly of a triangular figure. There may be distinguished

upon it an arched upper and lateral surface, a slightly concave lower surface (resting on the roof of the orbit), and a medial plane surface situated against the *falx cerebri*. The lower surface forms a triangle, the base of which is directed forward and the apex backward, and which corresponds to the *pars orbitalis* of the frontal bone. The French authors, who have been followed by most of the others, have incorrectly described these various surfaces separately as special lobes, and designated the lower orbital surface as *lobule orbitaire*, the upper and lateral as *lobe frontal*, while they describe the medial surface, together with the corresponding surface of the parietal lobe, as *lobe fronto-parietal*. The boundaries of the frontal lobe are formed on the upper and lateral surface by the *sulcus centralis*, which separates it from the parietal lobe, and on the lower surface by the oblique commencement of the *fissura Sylvii* and the *substantia perforata lateralis*, which separate it from the temporal lobe. On the medial surface there is no distinct separation from the parietal lobe.

CONVOLUTIONS AND FISSURES OF THE FRONTAL LOBE.

I. CONVOLUTIONS.

a. *Gyrus centralis anterior*, anterior central convolution. HUSCHKE. (A.)

SYN.—Processi enteroidei verticali di mezzo. (The anterior of them.)

ROLANDO.

Circonvolution transversale pariétale antérieure. FOVILLE.

Premier pli ascendant. GRATIOLET.

Antero-parietal gyrus. HUXLEY.

Ascending frontal gyrus. TURNER.

This constant convolution bounds the central fissure in front, and runs into the posterior central convolution both above and below, that is, at both ends of the fissure.

b. From the anterior central convolution there pass forward several series of gyri, the frontal, which run toward the apex of the hemispheres, and here turn around on to the lower surface, in order to converge toward and end at the posterior angle of the triangle presented by the lower surface. It is usual to separate three series or stories of convolutions lying one over another :

1. *Gyrus frontalis superior* (and *gyrus rectus* on the lower side). First or upper frontal convolution (F_1).

SYN.—Étage frontal supérieur s. troisième (and pli de la zone externe). GRATIOLET.

Supero-frontal gyrus. HUXLEY.

This convolution takes its origin from the upper (medial) portion of the anterior central convolution by one or several roots. The origin is usually a direct and superficial one, and is but seldom cut across

transversely by a fissure, since the *sulcus præcentralis* usually ends before reaching this place. In its further course this convolution is frequently divided by secondary fissures, and the divided portions again run together, and, since such divisions occur in it, in variable number, and sometimes more or less developed connections are formed with the following (middle) frontal convolution, there arises the greatest variety in its arrangement in different individuals.

In this convolution an upper or lateral and a medial surface may be distinguished, which come together at the upper medial border of the hemisphere. The medial portion of this convolution (F, Fig. 4), (*pli de la zone externe* of Gratiolet), which lies in the longitudinal fissure of the brain, is separated from the gyrus encircling the *corpus callosum* (*Gf*) by the *sulcus calloso marginalis* (*cm*), and is not unfrequently separated by another fissure parallel with the one just mentioned, into two series of convolutions lying one over another. The upper frontal convolution grows considerably smaller as it bends around the anterior extremity of the hemisphere to reach the lower surface, and, having arrived there, passes directly backward as a small convolution bounding the medial fissure on each side, which is known as the *gyrus rectus* (*F*₁, Fig. 3).

2. *Gyrus frontalis medius* s. *secundus* (F_2). Second or middle frontal convolution.

SYN.—Étage frontal moyen. GRATIOLET.

Medio-frontal gyrus. HUXLEY.

This convolution arises from the anterior central below and outside of the above-named; its origin is more frequently a concealed one, that is, the convolution appears cut across at its origin by a more or less deep fissure (*sulcus præcentralis*, F_3). In its course toward the anterior extremity of the hemisphere this series of gyri, which is from its origin usually the broadest of the three frontal convolutions, becomes considerably broader, and, in much convoluted brains, is complicated, often to a high degree, by numerous divisions and connections. In consequence of this, its single gyri, as Bischoff¹ correctly remarks, run almost horizontally, and there is sometimes formed, as Huschke² has pointed out, in the neighborhood of the frontal eminence, a sort of funnel by the meeting of the summits of several arched convolutions at this place. Arrived at the orbital surface, the convolution soon begins to grow smaller, and, converging with the first and third, forms the posterior angle of the triangle representing the orbital surface of the frontal lobe.

¹ L. c., S. 37.

² L. c., S. 140.

FIG. 1.



VIEW OF THE BRAIN FROM THE SIDE.

F' Frontal lobe; *P* parietal lobe; *O* occipital lobe; *T* temporal lobe.

S Fissura Sylvii; *S'* horizontal, *S''* ascending branch.

c Sulcus centralis; *A* anterior, *B* posterior central convolution.

F_1 Upper, F_2 middle, F_3 lower (or third) frontal convolution.

f_1 Upper, f_2 lower, f_3 vertical frontal fissure (sulcus præcentralis).

P_1 Upper, P_2 lower parietal lobule; P_2 gyrus supramarginalis, P_2' gyrus angularis.

ip Sulcus interparietalis.

cm End of the sulcus calloso-marginalis.

O_1 First, O_2 second, O_3 third, occipital convolution.

po Fissura parieto-occipitalis.

o Sulcus occipitalis transversus.

o₂ Sulcus occipitalis longitudinalis inferior.

T_1 First, T_2 second, T_3 third temporal convolution.

t_1 First, t_2 second temporal fissure.

3. *Gyrus frontalis tertius* s. *inferior*, third or lower frontal convolution (F_3).

SYN.—Pli frontal inférieur s. premier, s. étage surcilier. GRATIOLET.¹
Infero-frontal gyrus. HUXLEY.

This convolution arises from the lower part of the anterior central, borders from above the anterior portion of the horizontal division of the *fossa Sylvii*, takes part in the formation of the *operculum*, which covers the island from above, and passes thence arching over the anterior ascending part of the *fissura Sylvii* (S'') first forward and then inward, toward the posterior angle of the triangular orbital surface of the frontal lobe. If, as frequently happens, the anterior ascending branch of the *fissura Sylvii* radiates at its extremity into several secondary fissures, these also receive from this convolution arched borders, and there arise in its course often very multiplied undulations.²

II. FISSURES.

On the upper or lateral surface the three frontal

¹ Bischoff expresses himself most decidedly and correctly against the introduction of the name *pli surcilier*, or ocular convolution, into the anatomy of the human brain, where it has neither a topographical nor physiological foundation.

² It is this convolution, as is well known, injury to which on the left side is connected, according to the observations of Broca and others, with loss or disturbance of the faculty of articulate language without disturbance of the intellect.

convolutions described above are separated from each other by two fissures :

1. *Sulcus frontalis superior*, upper frontal fissure (f_1), separates the upper or first frontal convolution from the second.

SYN.—Supero-frontal sulcus. HUXLEY.

2. *Sulcus frontalis inferior*, lower frontal convolution (f_2).

SYN.—Infero-frontal sulcus. HUXLEY.
Sulcus frontalis medius.¹ PANSCH.

The development of the fissures just named is variable. Very frequently they are bridged over in various places by secondary convolutions which connect the single frontal convolutions with each other. A third fissure runs in a direction approaching the vertical, thus forming an angle with the preceding. This is the—

3. *Sulcus præcentralis*, or vertical frontal fissure² (f_3).

SYN.—Antero-parietal sulcus. HUXLEY.
Ramus descendens sulci frontalis medii.³ PANSCH.

¹ Pansch names it *medius* because in the apes still another fissure is found beneath this, which runs horizontally forward, but has nothing to do with the boundary of convolutions.

² I prefer this name because this fissure is always situated in front of the central fissure, and runs in a direction nearly parallel to it; that is, not horizontal, like the other frontal fissures, but vertical.

³ Gratiolet (l. c., S. 25) has given no special name to this fissure,

This tolerably constant fissure helps to form the anterior boundary of the anterior central convolution, and passes upward between the anterior ascending branch of the *fissura Sylvii* (S''), and the lower end of the *sulcus centralis* (c). It is separated from the *fissura Sylvii* by the origin of the lower frontal convolution from the anterior central, and sometimes cuts a little into it, but I have never seen a complete union with the *fissura Sylvii*. When this occurs, which is certainly not often, the place where it happens is always situated behind the ascending branch of the *fissura Sylvii*.¹

This fissure divides in ascending, and sends a branch backward and upward, which runs along the anterior border of the anterior central convolution, and helps to bound it in front. Sometimes, by passing farther upward, it separates the origin of the middle frontal convolution wholly, and even that of the upper partially, from the anterior central. A second branch turns forward, and unites with the *sulcus frontalis inferior*² (f_2). I find, as a rule, that fissure

though he describes it very accurately in the brain of *Cercopithecus*, and has figured it in the human brain.

¹ Turner (l. c., S. 9, Fig. 1) has, as I think incorrectly, identified this fissure with the ascending branch of the *fissura Sylvii*, and considers its separation from the latter by a superficial origin of the lower frontal convolution from the gyrus centralis anterior, as the exception.

² Huxley (l. c., S. 257) says that it opens into the supero-frontal sulcus (*sulcus frontalis superior*), a statement which probably depends on a slip of the pen.

unmistakably indicated in the foetal brain from the sixth lunar month, and consider it typical.

On the medial surface, the upper frontal convolution is not unfrequently divided into two groups of convolutions lying one above the other by a fissure parallel with the *sulcus calloso-marginalis*.

The lower surface of the frontal lobe, as already mentioned, has the form of a triangle, whose base is directed forward, and lies in the angle between the *pars frontalis* and *orbitalis* of the frontal bone, while its apex looks backward, and corresponds to the apex of the pyramid formed by the orbit. The medial leg of the triangle is parallel with the medial, and the lateral with the lateral wall of the orbit.

The fissures formed upon the surface are (s. Fig. 3):

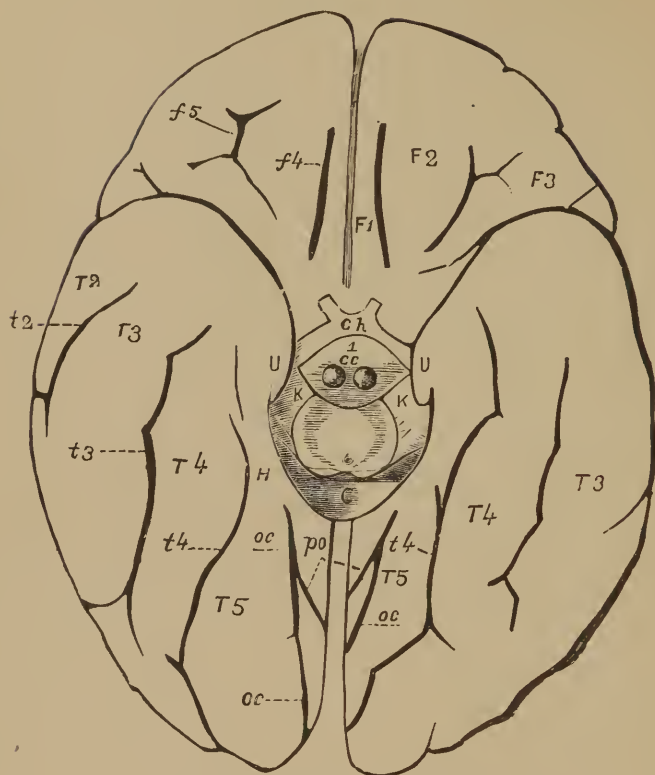
4. *Sulcus olfactorius*, fissure for the olfactory nerves (f_4).

This runs parallel with the medial leg of the before-mentioned triangle, and forms the lateral boundary of the prolonged first frontal convolution (*Gyrus rectus*, F_1) which is situated along the medial fissure. The *tractus olfactorius* is embedded therein.

5. *Sulcus orbitalis* (f_5).

The remaining fissures on the lower surface of the frontal lobe are very variable in form. A fissure

FIG. 3.



VIEW OF THE BRAIN FROM BELOW.

*F*₁ Gyrus rectus, *F*₂ middle, *F*₃ lower frontal convolution.

*f*₄ Sulcus olfactorius, *f*₅ sulcus orbitalis.

*T*₂ Second, or middle, *T* third, or lower temporal convolution; *T*₄ gyrus occipito-temporalis lateralis (lobulus fusiformis), *T*₅ gyrus occipito-temporalis medialis (lobulus lingualis).

*t*₄ Sulcus occipito-temporalis inferior, *t*₅ lower, *t*₂ middle temporal fissure.

po Fissura parieto-occipitalis.

oc Fissura calcarina.

H Gyrus hippocampi; *U* gyrus uncinatus.

Ch Chiasma nervorum opticorum; *cc* corpora callosa (albicantia); *KK* pedunculi cerebri; *C* corpus callosum.

is usually present, parallel with the lateral leg of the before-mentioned triangle, which separates the second and third frontal convolution from each other, and which I will call *sulcus orbitalis*. Sometimes another fissure passes forward from this, producing the figure of a three-rayed star, or of an H, whence come the names, triradiate sulcus, Turner ;¹ and *solco crociforme*, Rolando.²

In much-convoluted brains³ the single frontal convolutions are divided by so many secondary fissures, while, on the other hand, the important separating fissures (*sulcus frontalis superior, inferior*) are bridged over by so many connecting convolutions that it is often not easy to determine what belongs to one convolution and what to another.⁴

In order to learn the frontal convolution, it is necessary, first of all, to examine very slightly convoluted brains, such as those of the new-born, but especially foetal brains from the last months of pregnancy. In these the architectural plan of the human frontal lobe is reduced to its simplest expression, and all the really typical parts can be recognized almost as

¹ Turner, l. c., p. 15, Fig. 3, TR.

² Rolando, l. c., S. 32.

³ Compare the figures of R. Wagner.

⁴ Gratiolet (l. c., S. 9) finds, in regard to the relation of the three frontal convolutions to each other, that, in Europeans, the lower frontal convolution is the most isolated, while the middle and upper run into each other abundantly ; in the Bushman, on the contrary, the upper remains independent, while the middle and lower often blend.

in a diagram, without the view being disturbed and led away from the essential, by many secondary fissures and convolutions arising at a later period, and corresponding in a measure to a richer ornamentation.

B. PARIETAL LOBE. *Lobus parietalis*. P.

We distinguish on the parietal lobe an upper (at the same time lateral) surface, which lies in the concavity of the parietal bone, and a medial plane surface which looks toward the great longitudinal fissure. It is separated on the upper surface from the frontal lobe by the *sulcus centralis*, from the temporal lobe, at least in great part, by the *fissura Sylvii*, and from the *occipital lobe* incompletely by the *fissura parieto-occipitalis*.¹ On the medial surface the separation from the occipital lobe by the fissure just mentioned is a complete one. On this surface a fissure (*sulcus calloso marginalis*, Huxley) rises behind the upper end of the posterior central convolution toward the medial upper border of the hemisphere, and, together with the *fissura parieto-occipitalis*, marks off on this surface a quadrangular space which has been distinguished as a special lobe by several authors—by

¹ I must deny that the *sulcus occipitalis*, when it is present, forms the boundary, as has been asserted. I find that this fissure always takes its course over the cuneus, that is, a part of the occipital lobe, and not between this and the parietal.

Burdach as *Vorzwinkel, præcuneus*; by Foville as *lobule quadrilatère*.

FISSURES, LOBULES, AND CONVOLUTIONS OF THE PARIETAL LOBE.

1. *Gyrus centralis posterior* (*B*), posterior central convolution.

SYN.—Processi enteroidei verticali di mezzo (the posterior). ROLANDO.

Circonvolution transverse medio-pariétale. FOVILLE.

Deuxième pli ascendant. GRATIOLET.

Ascending parietal convolution. TURNER.

Postero-parietal gyrus. HUXLEY.

From this convolution which bounds the central fissure posteriorly, and is in connection at the upper and lower ends with the anterior central convolution, pass backward the convolutions of the parietal lobe, the arrangement of which is principally determined by the following fissure.

2. *Sulcus interparietalis*, parietal fissure (*ip*).

SYN.—Sulcus parietalis. PANSCH.

Intra-parietal fissure. TURNER.¹

This fissure, although appearing very regularly in the brain of the apes as well as in that of man, and seldom wanting in the numerous representations of these brains, is described as an important and typical

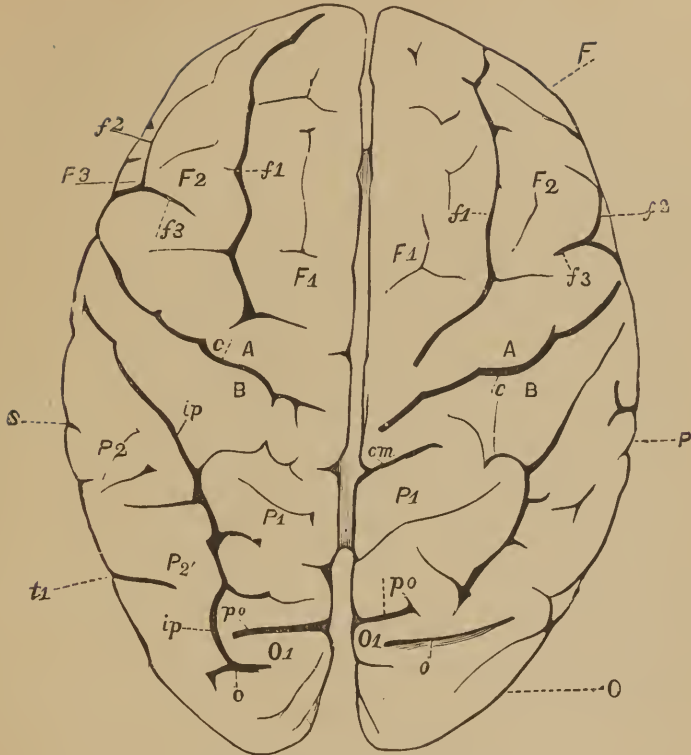
¹ Turner: Notes more especially on the bridging convolutions, etc., p. 4. The convolutions of the human cerebrum, etc., p. 12.

one, with a special name, only by Pansch and Turner.¹

It passes obliquely backward through the parietal lobe, and separates it into two subordinate divisions, the upper or medial, and the lower or lateral parietal lobule—*lobulus parietalis superior* and *inferior* (P_1 and P_2). This fissure, which is already to be recognized upon the brain of the sixth month's foetus, begins just above the posterior branch of the *fissura Sylvii*, and is separated from it by the arched convolution which connects the lower end of the posterior central convolution (B) with the *gyrus supra-marginalis*. It then rises obliquely upward behind the posterior central convolution, separating, in the first ascending portion of its course, the convolution just named (B) from the anterior part of the lower parietal lobule (*gyrus supra-marginalis*, P_2), then turns backward and obliquely inward toward the lateral end of the *fissura parieto-occipitalis* (po), which, however, it does not reach; but, being separated from it by the *gyrus occipitalis primus*, which passes from the parietal to the occipital lobe between these two fissures, continues its course backward nearly parallel with the upper median border of the hemisphere, to end sometimes sooner and sometimes

¹ Bischoff admits that the fissure is present in the foetus, and typical, but opposes the meaning given to it by other authors in the adult brain.

FIG. 2.



VIEW OF THE BRAIN FROM ABOVE.

- F* Frontal lobe, *P* parietal lobe, *O* occipital lobe.
*S*₁ End of the horizontal branch of the fissura Sylvii.
c Central fissure; *A* anterior, *B* posterior central convolution.
*F*₁ Upper, *F*₂ middle, *F*₃ lower frontal convolution.
*f*₁ Upper, *f*₂ lower, *f*₃ vertical frontal fissure (sulcus præcentralis).
*P*₁ Upper, *P*₂ lower parietal lobule; *P*₂ gyrus supramarginalis, *P*₂' gyrus angularis.
ip Sulcus interparietalis.
cm Sulcus callosomarginalis.
po Fissura parieto-occipitalis.
*t*₁ Upper temporal fissure.
*O*₁ First occipital convolution.
o Sulcus occipitalis transversus.

later. Sometimes its extremity opens into the transverse fissure (*sulcus occipitalis*) (*o*), at others it stretches almost to the apex of the *lobus occipitalis*.

The fissure is often less distinct, for the reason that it is bridged over at one place or another by a secondary convolution; this appears to happen more often on the right side than the left. It is thereby completely separated into an anterior and posterior division.¹ An occurrence of this kind is certainly no more frequent in this fissure than in others which generally pass without hesitation as typical—for instance, the temporal fissures.

The *fissura interparietalis* separates the parietal lobe on the upper lateral surface into two divisions: an upper medial, lying near the great longitudinal fissure, and a lower lateral, bordering the *fissura Sylvii*, which we distinguish as the upper and lower parietal lobules.

3. *Lobulus parietalis superior*, upper parietal lobules (P_1), and præcuneus (P_1').

a. Upper parietal lobule.

SYN.—Gyrus parietalis superior (excluding posterior central convolution). PANSON.

Lobule du deuxième pli ascendant. GRATIOLET.

Postero-parietal lobule. HUXLEY, TURNER, and the other English authors.

¹ Compare note 3, page 29.

Erste Scheitellappenwindung (gyrus parietalis superior). R.

WAGNER.

Oberer Scheitelbeinlappen. HUSCHKE.

Obere innere Scheitelgruppe. BISCHOFF.

b. Præcuneus (Vorzwickel). BURDACH.

Lobule quadrilatère. FOVILLE.

Quadrangle lobule. HUXLEY.

This lobule is formed, as Huschke has correctly stated, and as Gratiolet indicates by his nomenclature, by the extension backward of the upper end of the posterior central convolution, and its development to a lobule consisting of several gyri, which stretches backward to the *fissura parieto-occipitalis*, and is in connection with the occipital lobe by means of the *gyrus occipitalis primus* (O_1), which borders the lateral end of the fissure just named.

We can distinguish in this lobule an upper lateral and a medial surface which pass into each other at the upper medial border of the hemisphere, with a distinct boundary.

a. On the lateral surface, the upper parietal lobule is bounded externally by the *fissura interparietalis*; anteriorly it passes, without distinct boundary, into the posterior central convolution; while the posterior portion is separated from the occipital convolution on the inner side by the upper part of the *fissura parieto-occipitalis*, but externally is directly connected therewith by the *gyrus occipitalis primus*,

which borders the lateral extremity of this fissure. The medial surface is in several directions so very plainly marked out that it was one of the first divisions distinguished upon the cerebral surface. This is the—

b. *Præcuneus* (Vorzwickel). BURDACH.

I retain Burdach's nomenclature of the medial surface. The *præcuneus* is clearly and sharply marked off from the occipital lobe, especially the *cuneus* (*Oz*), by the *fissura parieto-occipitalis* (*po*); anteriorly it is bounded by the perpendicularly rising end of the *fissura calloso-marginalis* (*cm*). This fissure ends behind the posterior central convolution, with an indentation upon the medial border of the hemisphere, which is distinguishable on most brains, and usually on the brain of the fœtus from the seventh to the eighth month.¹ Below, the *præcuneus* is connected, as will be more accurately described hereafter, with the *gyrus fornicatus*.

4. *Lobulus parietalis inferior*, lower parietal lobules (*P₂* and *P₂'*).

SYN.—*Gyrus parietalis inferior*. PANSCH.

¹ Since the posterior central convolution also belongs to the parietal lobe, the anterior boundaries of the *præcuneus*, that is, of the middle part of the parietal lobe, are not the same with those of the lateral part. In the latter situation the parietal lobe reaches to the central fissure, in the former only to the posterior border of the posterior central convolution.

This lies below and laterally from the *fissura interparietalis*, and consists of a more or less complicated system of convolutions, which, however, in their general direction, curve around the upper ends of the *fissura Sylvii* and the *fissura temporalis superior* downward to the temporal lobe. It may usually be separated into two divisions, an anterior and posterior, of which the first surrounds the end of the *fissura Sylvii*, the latter that of the *fissura temporalis superior*.

A. Anterior division, *Lobulus supra-marginalis* (P_2).

SYN.—Pli marginal supérieur, and lobule du pli marginal supérieur.
GRATIOLET.

Dritte Scheitellappenwindung. Gyrus parietalis tertius s. inferior. R. WAGNER.

Unterer Zug aus der hintern Centralwindung und Scheitelhöckerläppchen, lobulus tubercis. HUSCHKE.

Erste oder vordere Scheiteltbogenwindung (Nr. 11). BRISCHOFF.

This lobule lies between the lower end of the posterior central convolution and the upper end of the *fissura Sylvii*, and arises from the lower end of the former, which forms the posterior part of the operculum, then develops into a lobule, consisting of several convolutions, arched around the end of the *fissura Sylvii*, in order finally to become the lower boundary of this fissure as the *gyrus marginalis inferior* or *temporalis superior* (T_1).

B. Posterior division. *Gyrus angularis*, angular gyrus. HUXLEY. (P_2')

SYN.—Pli courbe. GRATIOLET.

Zweite oder mittlere Scheitellappenwindung. Gyrus parietalis secundus s. medius. R. WAGNER.

Aufsteigende Windung sum hintern äussern Scheitelläppchen und hinteres äusseres Scheitelläppchen. HUSCHKE.

Zweite oder mittlere Scheitelbogenwindung (Nr. 12). BRISCHOFF.

This convolution proceeds backward from the above-named lobule, is bounded above by the *fissura interparietalis*, is continuous posteriorly without definite boundaries with the occipital lobe, principally with the *gyrus occipitalis secundus* (O_2), and, arching round the upper end of the first temporal fissure (t_1), passes into the middle temporal convolution, *gyrus temporalis medius* (T_2). Sometimes this convolution is connected with the *lobulus parietalis superior* by a bridge crossing the *fissura interparietalis*.

In much-convoluted brains both the before-mentioned groups of gyri are very complicated, and it is difficult to decipher them. To get an understanding of the convolutions in this neighborhood, it is necessary to consult brains with few windings, and especially those from the last months of foetal life.

C. OCCIPITAL LOBE. *Lobus occipitalis.* (O.)

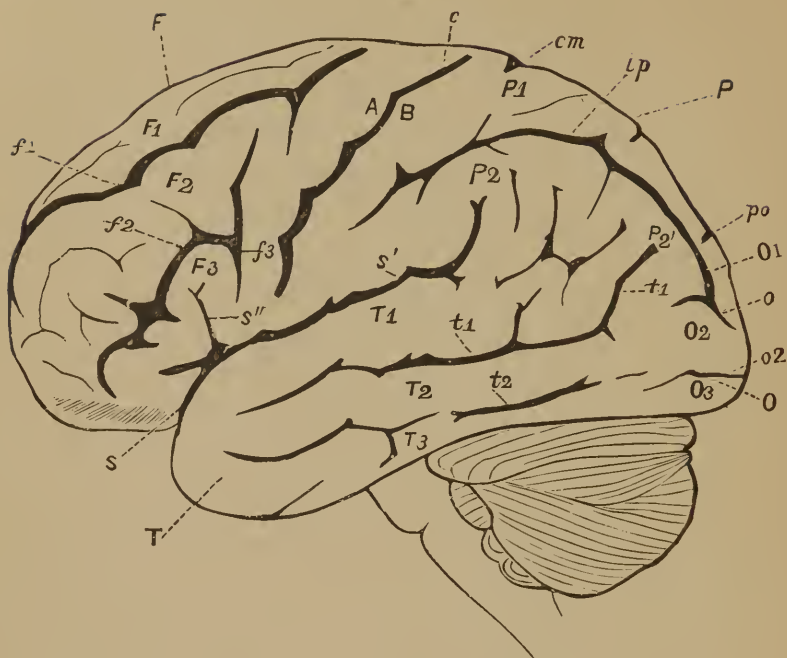
The occipital lobe in man may be called small in comparison with the rest of the hemisphere. It forms the posterior extremity of the hemisphere, fills the upper fossa of the occipital bone, and rests upon the tentorium. Three surfaces may be distinguished thereon—a medial, lying against the falx cerebri, a lateral or upper, and a lower, lying upon the tentorium—all three of which coalesce at the posterior point of the hemisphere. The medial surface is plane, the upper vaulted, the lower slightly concave.

The limitation of the occipital lobe toward those adjoining it anteriorly is, with the exception of a few places, rather indistinct.

On the medial surface it is the most clearly marked. Here the medial portion of the *fissura parieto-occipitalis* (*po*) separates the occipital lobe, in particular the cuneus, very sharply from the parietal lobe, in particular the præcuneus.

On the upper surface this separation is also indicated by the lateral portion of the same fissure, but in very different degrees, since the extent of the fissure is sometimes more and sometimes less. From the point where the fissure ceases on the upper surface of the hemisphere, the anterior boundary of the *lobus occipitalis* becomes indistinct, and the lobe out-

FIG. 1.



VIEW OF THE BRAIN FROM THE SIDE.

- F* Frontal lobe ; *P* parietal lobe ; *O* occipital lobe ; *T* temporal lobe.
S Fissura Sylvii ; *S'* horizontal, *S''* ascending branch.
c Sulcus centralis ; *A* anterior, *B* posterior central convolution.
*F*₁ Upper, *F*₂ middle, *F*₃ lower (or third) frontal convolution.
*f*₁ Upper, *f*₂ lower, *f*₃ vertical frontal fissure (sulcus præcentralis).
*P*₁ Upper, *P*₂ lower parietal lobule ; *P*₂ gyrus supramarginalis, *P*₂' gyrus angularis.
ip Sulcus interparietalis.
cm End of the sulcus callosomarginalis.
*O*₁ First, *O*₂ second, *O*₃ third, occipital convolution.
po Fissura parieto-occipitalis.
o Sulcus occipitalis transversus.
*o*₂ Sulcus occipitalis longitudinalis inferior.
*T*₁ First, *T*₂ second, *T*₃ third temporal convolution.
*t*₁ First, *t*₂ second temporal fissure.

side of this place passes without distinct boundaries into the parietal as well as into the temporal lobe, by a number of groups of convolutions, which are developed in very different degrees in different cases.¹ The more they are developed, the more is the before-mentioned fissure pressed back toward the medial border of the hemisphere, and the more indistinct becomes the anterior boundary of the occipital lobe.

On the under or tentorium surface there is nowhere any distinct line between the occipital and temporal lobes; only in perfectly fresh brains or in such as have been hardened within the cranium there may be found a shallow, transverse depression approximately indicating the limits of the two divisions. This depends on the impression of the upper edge of the petrous bone, and usually disappears soon after taking out the brain.²

FISSURES, DIVISIONS, AND CONVOLUTIONS OF THE OCCIPITAL LOBE.

1. *Sulcus occipitalis transversus*. Posterior or transverse occipital fissure (*o*).

SYN.—Fissura occipitalis externa. PANSCH.

Fissura occipitalis perpendicularis externa. BISCHOFF.

¹ These are the convolutions to be more accurately described farther on, which, in the apes, were named by Gratiolet *plis de passage*.

² Compare Krause, "Handbuch der Anatomie," Hannover, 1838, I. 3, S. 853, Bischoff, l. c., S. 29.

Over the upper surface of the occipital lobe, and in particular over the base of its triangular lobule called the cuneus, there runs a transverse fissure, to which I have given the above name. It is sometimes wanting, and sometimes only very slightly developed, yet it seems to have a certain morphological meaning. In the cases in which it is duly perfected we find at a distance behind the *fissura parieto-occipitalis* a transverse fissure, which is often quite deep, and into which the *fissura interparietalis* very frequently opens anteriorly. Around its medial extremity runs an arched convolution, which is an immediate continuation of that which has bordered the lateral extremity of the *fissura parieto-occipitalis*; it is, therefore, the *gyrus occipitalis primus* (O_1), soon to be spoken of. In some cases I have seen the posterior border of the fissure thinned off so as to lie on the anterior border like a lid, a condition which strongly reminds one of the operculum of the ape's brain. In the foetus the fissure is to be clearly recognized at a tolerably early period, as Bischoff also states;¹ that it regularly disappears again in the eighth month, as he assumes,² I can, after what has just been stated, in no way admit.

¹ L. c., S. 58, Tb. IV., Figs. 7 to 9, C'.

² L. c., S. 60.

2. *Fissura calcarina*. HUXLEY.

SYN.—Scissure des Hippocampes (posterior part). GRATIOLET.

Fissura horizontalis. PANSCH.

Fissura posterior s. occipitalis horizontalis. R. WAGNER.

Fissura Hippocampi. BISCHOFF.

This very constant fissure which, with the *fissura parieto-occipitalis*, appears in the fœtus before any others, and is completely developed at an early period, begins upon the medial surface of the posterior extremity of the hemisphere, with two branches which diverge backward into an upward and downward fork, runs thence forward and joins the *fissura parieto-occipitalis* at an acute angle. From here it continues as a common prolongation of the two fissures to beneath the posterior extremity of the *corpus callosum*. Here it is bordered by the *gyrus fornicatus*, and separated from the *fissura hippocampi* (*h*). This fissure is very deep, and, as transverse sections most clearly show, gives rise to the prominence in the posterior horn of the lateral ventricle, known as *calcar avis*, or *pes hippocampi minor*. Hence the name given by Huxley.

3. *Sulcus occipito-temporalis inferior*.

Since this fissure upon the lower surface of the occipital lobe belongs also to the temporal, I postpone its consideration till the description, to be given below, of the lower surfaces of these two lobes together.

DIVISIONS OF THE *Lobus Occipitalis*.

a. Such is to be clearly found only on the medial surface. Here may be distinguished—

1. The *cuneus* (Zwickel). BURDACH (*Oz*).

SYN.—Lobule occipital. GRATIOLET.

Internal occipital lobule. HUXLEY.

Gyrus occipitalis primus. Erste obere Hinterhauptlappenwindung. WAGNER.

Oberer Zwischenscheitelbeinlappen. HUSCHKE.

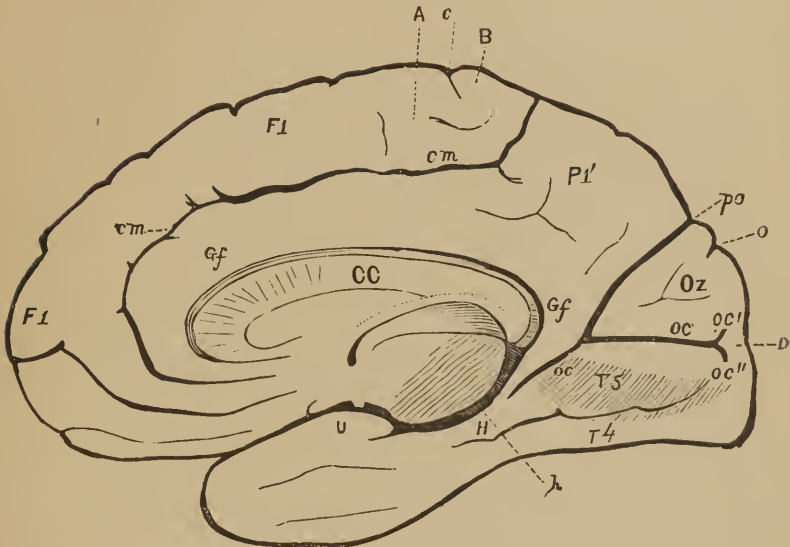
Since the *fissura calcarina* unites on this surface with the *fissura parieto-occipitalis* at an acute angle, a triangular, wedge-shaped piece is cut from the anterior part of the lobus occipitalis, the base of which looks upward and backward, and the apex downward and forward. This is the cuneus.

2. There may, besides, be separated on the medial surface, and just at the posterior apex of the hemisphere, a lobule which forms the extreme point of the hemisphere, and is situated behind the diverging ends of the *fissura calcarina*. I will name it “end lobule,” *lobulus extremus*.

3. That portion which lies below the *fissura calcarina* belongs to the lower surface of the *lobus occipitalis*, the convolutions of which pass into those of the temporal lobe without distinct boundaries, and will, therefore, be described in common with the latter in a special section.

4. On the upper and lateral surface there is likewise no distinct subordinate division into lobules.

FIG. 4.



VIEW OF THE MEDIAL SURFACE OF THE RIGHT HEMISPHERE.

CC Corpus callosum, cut through in the middle.

Gf Gyrus fornicatus, H gyrus hippocampi, h sulcus hippocampi, U gyrus uncinatus.

cm Sulcus callosus-marginalis, F₁ first frontal convolution, its medial side, c end of sulcus centralis, A anterior, B posterior central convolution.

P' Præcuneus.

Oz Cuneus, po fissura parieto-occipitalis, o sulcus occipitalis transversus, oc fissura calcarina, oc' upper, oc'' lower branch. D Gyrus descendens.

T₄ Gyrus occipito-temporalis lateralis (lobulus fusiformis).

T₅ Gyrus occipito-temporalis medialis (lobulus lingualis).

Only when the *sulcus occipitalis transversus* (o) is distinctly developed, the upper surface of the occipi-

tal lobe appears separated into an anterior and posterior portion. It may be proper to repeat here that such a division does not at all correspond to those upon the medial surface, and thus does not divide the præcuneus from the cuneus, or the latter from the convolutions of the lower surface, but the *sulcus occipitalis transversus* rather runs transversely across the upper surface or base of the cuneus.

CONVOLUTIONS OF THE OCCIPITAL LOBE.

There is indeed no doubt that the understanding of the convolutions of the occipital lobe is in itself more difficult than that of all the other lobes. Yet, I think I am not wrong in supposing that the difficulties inherent in the nature of the subject, arising especially from the great individual variety in the convolutions of the region, have been materially increased by transferring, not without doing some violence to nature, the nomenclature of the monkey-brain directly to that of man. In no part of the cerebral surface is the difference between the brains of those apes (*Cercopithecus*, etc.) upon which Gratiolet's description was founded, and the human brain, more distinct than in this very occipital lobe. In the apes which form the genera *Cercopithecus*, *Inuus*, *Cynocephalus*, *Cebus*, etc., the occipital lobe

is separated from the parietal on the upper surface by a deep transverse indentation, and the posterior border of this fissure (*scissure perpendiculaire*, Gratiolet), that is, the anterior border of the posterior lobe, is brought to an edge, and projects over the fissure like a lid, whence its name *operculum*. Covered by this lid, that is, lying in the depths of the fissure, several convolutions pass from the upper and lower parietal lobules to the occipital lobe. These hidden convolutions, of which there are two, and which are, of course, from their concealed position, entirely peculiar, Gratiolet thought it necessary to distinguish by a special name, and he called them *plis de passage* (transition convolutions). But he has also given this name to two other convolutions, which lie, too, upon the upper surface, and laterally from the former, and connect the temporal with the occipital lobe. These last two convolutions are, however, never concealed even in the above-named apes, but lie entirely on the surface. Finally, Gratiolet has designated as *plis de passage* still two other convolutions on the medial surface, which are also superficial, and which connect the parietal with the occipital lobe (in particular, præcuneus and cuneus). The latter he names inner *plis de passage*,¹ and separates them as upper and lower: those first described he

¹ For these, see the convolutions of the medial surface.

calls outer, and distinguishes them in their order, reckoning from the medial border of the hemisphere, as first, second, third, and fourth. Thus, even in these apes, it is only the first and second outer *plis de passage* which exhibit any thing peculiar, and deserve a special name; the others have, in fact, nothing to distinguish them from other convolutions which connect different lobes with each other; and one might, with as much propriety, reckon, among the *plis de passage*, the convolutions of the lower surface which connect the occipital and temporal lobes. Besides, in many of the higher apes the operculum is entirely wanting, and with it disappears the only peculiarity which has distinguished these convolutions. These are, then, superficial convolutions, like all the others.

So it is also in man. Neither in the adult brain, nor at any period of foetal life, do these convolutions show any peculiarity which justifies a special nomenclature, or one which seems to indicate something special, such as "transition convolutions." They are never particularly concealed. The two hidden convolutions, and the operculum connected therewith, are thus a peculiarity of the lower forms of apes, which is wanting even in the higher ones, and still more in man. It must necessarily lead to false views if a nomenclature is retained in the anatomy

of the human brain, which has, indeed, a meaning in the lower apes, but none at all in man. It is, however, none the less true that the type of the convolutions in the human brain, taken as a whole, is only a higher development of that of the apes, whether this is taken in the meaning of the descendance theory or in the old sense.

In order to gain a clear view, disturbed by no preconceived notion, of the convolutions of the human occipital lobe, it is, first of all, necessary to examine numerous fœtal brains from the last (seventh, eighth, ninth, tenth lunar) months of pregnancy. Here the structural plan of the human brain is exhibited in its simplest lines, while later the essential is often no longer to be so easily separated from the non-essential. The convolutions of the occipital lobe run in general from the posterior point of the hemisphere forward on the upper (also lateral), the medial, and the lower surfaces, diverging on account of the increase in diameter of the hemisphere, and pass into those of the parietal and temporal lobes. The separation of certain intermediate portions under the name of transition convolutions (*plis de passage*), between the convolutions of the occipital lobe on the one hand, and the parietal and temporal on the other, has no justification in the human brain, and makes the understanding of the region more

difficult. I have, therefore, wholly rejected this name.

The convolutions which I separate upon the *lobus occipitalis* are the following :

I. ON THE UPPER SURFACE.

1. *Gyrus occipitalis primus* s. *parieto-occipitalis medialis*, first or upper occipital convolution (O_1).

SYN.—Oberer Zug der hintern Centralwindung (in part). HUSCHKE.

Erste obere Hinterlappenwindung. WAGNER.

Pli de passage supérieur externe and pli occipital supérieur.

GRATIOLET.

First external annectent gyrus (HUXLEY); first bridging annectent or connecting gyrus. TURNER.

Obere innere (4.) Scheitelbogenwindung (Nr. 14). BISCHOFF.

Huschke has already described a convolution which reaches from the posterior central convolution along the median fissure to the posterior extremity of the brain, and from there passes to the lower surface. This convolution connects the upper parietal lobule with the lobus occipitalis, and forms the upper medial portion of the latter, so that the name I have given it is justified. Gratiolet, on account of a peculiarity presented in certain apes by the convolution, has divided it into two (*pli de passage supérieur externe*, and *pli occipital supérieur*), a division which, as above stated, is not a well-founded one in man. This fissure arises from the posterior and medial end of the upper parietal lobule, surrounds in

an arch of greater or less extent, convex outward, the lateral upper extremity of the *fissura parieto-occipitalis* (*po*) which separates the parietal (P_1) from the occipital lobe (O), and passes into the cuneus, on the upper surface of which it borders the medial end of the *sulcus occipitalis transversus* (*o*), when this is present, in a second arch with its convexity toward the median line.

2. *Gyrus occipitalis secundus, seu parieto-occipitalis lateralis*, second or middle occipital convolution (O_2).

SYN.—Pli occipital moyen and deuxième pli de passage externe.

GRATIOLET.

Zweite mittlere Hinterlappenwindung. WAGNER.

Gyrus occipitalis medius. PANSCH.

Medio-occipital and second external annectent gyrus. HUXLEY.

This convolution lies behind and outside of the preceding, arises from the posterior extremity of the hemisphere behind the *sulcus occipitalis transversus* (*o*), and outside of the *fissura interparietalis*, runs forward to the lower parietal lobule, and passes especially into the *gyrus angularis* (P_2'); it is separated from the preceding by the *fissura interparietalis*.

3. *Gyrus occipitalis tertius seu tempora-occipitalis*, third or lower occipital convolution (O_3).

SYN.—Pli occipital inférieur and troisième et quatrième pli de passage externe. GRATIOLET.

Dritte untere Hinterlappenwindung. WAGNER.

Gyrus occipitalis inferior. PANSCH.

This convolution also runs from the posterior extremity of the hemisphere below the preceding, to the third and second temporal convolutions.

All the three convolutions named above arise from a part of the occipital lobe which is marked off on the medial surface as the cuneus. Below the *cuneus* and the *fissura calcarina*, and consequently on the lower surface of the occipital lobe, two other convolutions may be separated. These are—

4, 5. *Gyri occipito-temporalis inferiores*.

To avoid unnecessary repetition, I defer the more accurate description of these convolutions—which belong both to the occipital and temporal lobes—until the description of the latter.

6. *Gyrus descendens* (*D*, Fig. 4).

The upper (numbered 1, 2, 3) and lower (numbered 4, 5) occipital convolutions are connected at the posterior extremity of the hemisphere by one or several convolutions which, arching around the fork of the *fissura calcarina*, and forming the terminal lobule, descend and are continued into the *lobulus*

fusiformis and *lobulus lingualis* (T_4 and T_5).¹ Huschke² has already said that the cuneus diverges at its basal surface into two branches like a V, of which the anterior bends around into the præcuneus, the posterior forms in its descent the apex of the hemisphere, and again bends upward opposite to itself, so that here two slender gyri lie concentrically in one another. Afterward this branch runs directly forward on the surface beside the cuneus, as a fusiform border-fold. Bischoff also mentions this convolution (l. c., S. 50).

7. *Sulci occipitales longitudinales* s. *sagittales*, longitudinal fissures of the occipital lobe.

Finally, as to the longitudinal fissures of the occipital lobe, by which the convolutions of the upper and lateral surface above described are separated from each other, they are, with the exception of the first, of very variable formation. If these convolutions, as is sometimes the case, converge until near the end of the lobe without material interruption from a *sulcus occipitalis transversus*, and cross the *lobulus extremus*, then these longitudinal or sagittal fissures, *sulci occipitales longitudinales*, as I will name

¹ Sometimes two such *gyri descendentes* can be distinguished (*medialis* and *lateralis*), of which the first ends in the *lobulus lingualis*, the second in the *lobulus fusiformis*.

² L. c., S. 143, 144.

them, in contradistinction to the *sulcus occipitalis transversus*, are, of course, the plainest. It is then easy to distinguish (*see* Fig. 1)—

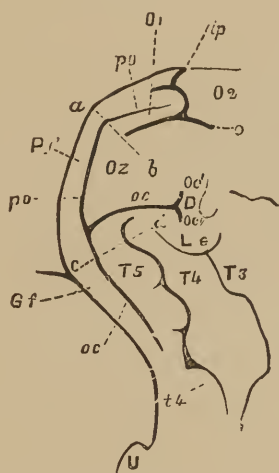
1. A *sulcus occipitalis superior* (o_1), which separates the *gyrus occipitalis primus* from the *secundus*, and is nothing but a convolution of the *sulcus interparietalis*; ¹
2. A *sulcus occipitalis inferior* (o_2), which separates the second from the third occipital convolution.

Thus we may separate, in all, five series of convolutions of the occipital lobe running in the antero-posterior direction, three on the upper and lateral surface (those described above as *gyrus occipitalis primus*, *secundus*, *tertius*), and two on the under surface (the *gyri occipito-temporales*, to be hereafter described, p. 66). Of the three first named, the upper is in connection solely with the *lobus parietalis superior*, the second with the lower parietal lobule and the second temporal convolution, and the third with the second and third temporal. The fourth and fifth are common to the occipital and temporal lobes (marked in the plates as T_4 and T_5).

¹ In the fœtus the two portions of the fissure, the posterior (sulc. occip. sup.) and anterior (sulc. interparietalis), arise separately from each other and subsequently unite.

NOTE.—We have above distinguished a *fissura parieto-occipitalis* (*po*) which separates the occipital lobe from the parietal, and *sulcus occipitalis*

FIG. 5.



THE CONVOLUTIONS OF THE POSTERIOR EXTREMITY OF THE HEMISPHERE, TAKEN FROM BEHIND, WITHIN, AND BELOW, AND PROJECTED ON A PLANE.

L. e. lobulus extremus, *Oz* cuneus.

P₁' præcuneus, *po* fissura parieto-occipitalis, *ip* fissura interparietalis.

o Sulcus occipitalis transversus, *oc* fissura calcarina, *oc'* upper, *oc''* lower branch; *t₄* sulcus occipito-temporalis inferior.

O₁ gyrus occipitalis primus, *O₂* gyrus occipitalis secundus.

D gyrus descendens, *Gf* gyrus fornicatus, *U* gyrus uncinatus, *T₆* lobulus lingualis, *T₄* lobulus fusiformis, *T₃* gyrus temporalis inferior.

The dotted line *ab* marks the boundary between upper and medial, the line *cd* that between the medial and lower surfaces.

transversus (*o*), which runs transversely over the upper surface of the occipital. If we seek the analogues of these fissures in the apes, we find, in the genera furnished with an operculum, apparently only one of them, the *fissura occipitalis transversus* (scissure perpendiculaire), present. If

we imagine, in the human brain, the *gyrus occipitalis primus* (O_1), which borders the outer end of the *fissura parieto-occipitalis*, and lies entirely superficial, sunk below the surface—as far as the *sulcus occipitalis transversus*—and the borders of the furrow left by this depression brought together, so that the posterior border of the fissure (being the posterior border of the *sulcus occipitalis transversus*) might project over it like a lid, we get the structure which is found in those ape-brains which have an operculum. Externally only one fissure is perceptible, the posterior border of which forms the operculum. Only at the bottom of this fissure is the *fissura parieto-occipitalis* seen, bordered by the hidden *gyrus occipitalis primus* (first outer *pli de passage*). On the other hand, if we imagine in the brain of an ape, for instance *Cercopithecus*, the convolution named thrust up to the surface, the transverse depression above described will be completely filled out, and we can distinguish two transverse fissures—in front the *fissura parieto-occipitalis*, bounded externally by the *gyrus occipitalis primus*; and farther backward the *sulcus occipitalis transversus*, whose medial extremity is also surrounded by the same convolution. With the great fissure, the *operculum* likewise disappears, and the occipital lobe appears much smaller. Compare especially Pansch, l. c., S. 25.

D. TEMPORAL LOBE, *lobus temporalis*; or, TEMPORO-SPHENOIDAL LOBE, *lobus temporo-sphenoidalis*.

The temporal lobe occupies on each side the middle fossa of the skull, thence lies lower than the frontal and occipital lobes, and principally forms the most deeply-situated part of the cerebrum, so that its apex lies at about the same height as the floor of the orbit. Its form, corresponding to that of the middle fossa of the skull, is cylindrical upon section,

and presents for description only two surfaces, which pass into each other by rounded borders.

The temporal lobe is the most distinctly bounded of all the lobes; in particular, it is very completely separated from the frontal and the anterior part of the parietal lobe by the *fissura Sylvii*, while, on the contrary, it is only indistinctly cut off from the posterior part of the last-named lobe and from the occipital. This is especially true of the lower surface, where the occipital convolutions pass into the temporal without any distinct limit, so that it is better, in order to avoid repetitions, to consider the lower surface of the two lobes together, as the lower occipito-temporal surface. It has already been mentioned that a shallow indentation at the boundary between the two lobes, caused by the upper edge of the petrous portion of the temporal bone, may be perceived in perfectly fresh brains, or those hardened within the skull. It has not, however, the slightest influence upon the convolutions.

FISSURES AND CONVOLUTIONS OF THE TEMPORAL LOBE.

FISSURES.

1. *Sulcus temporalis superior*, upper temporal fissure (t_1).

SYN.—Scissure parallèle. Parallel fissure. GRATIOLET.
Antero-temporal sulcus. HUXLEY.

This is the most constant fissure of the temporal lobe—runs parallel with the *fissura Sylvii* (hence the name given by Gratiolet), and marks off an upper temporal convolution, which bounds the *fissura Sylvii* on the lower side. It extends backward and upward to very different distances in different cases. Its posterior extremity lies, as a rule, higher than that of the *fissura Sylvii*, and in every case the convolution described above as *gyrus angularis* winds around it, to be continued into the second temporal convolution.

The two following fissures are much more inconstant, and very irregularly developed, interrupted, and bridged over, and very seldom both developed with equal clearness. These are—

2. The *sulcus temporalis medius*, middle temporal fissure (t_2),

postero-temporal sulcus (HUXLEY);

And 3. The *sulcus temporalis inferior*, the inferior temporal fissure (t_3).

These run parallel with the upper temporal fissure; the middle one lies almost entirely on the lateral surface of the temporal lobe, and only with its anterior lower extremity reaches the lower surface; while the lower, on the contrary, lies in its greatest part on this surface.

FIG. 1.



VIEW OF THE BRAIN FROM THE SIDE.

F Frontal lobe ; *P* parietal lobe ; *O* occipital lobe ; *T* temporal lobe.

S Fissura Sylvii ; *S'* horizontal, *S''* ascending branch.

c Sulcus centralis ; *A* anterior, *B* posterior central convolution.

*F*₁ Upper, *F*₂ middle, *F*₃ lower (or third) frontal convolution.

*f*₁ Upper, *f*₂ lower, *f*₃ vertical frontal fissure (sulcus præcentralis).

*P*₁ Upper, *P*₂ lower parietal lobule ; *P*₂ gyrus supramarginalis, *P*₂' gyrus angularis.

ip Sulcus interparietalis.

cm End of the sulcus callosus marginalis.

*O*₁ First, *O*₂ second, *O*₃ third, occipital convolution.

po Fissura parieto-occipitalis.

o Sulcus occipitalis transversus.

*o*₂ Sulcus occipitalis longitudinalis inferior.

*T*₁ First, *T*₂ second, *T*₃ third temporal convolution.

*t*₁ First, *t*₂ second temporal fissure.

Then follows a fissure which belongs to the lower surface alone, and is a part of the temporal as well as of the occipital lobe.

4. *Sulcus occipito-temporalis inferior*, inner lower longitudinal fissure (t_4).

SYN.—Sulcus longitudinalis inferior. HUSCHKE.

Sulcus occipito-temporalis. PANSCH.

Fissura collateralis. HUXLEY.

Fissura collateralis s. temporalis inferior. BISCHOFF.

This fissure runs upon the lower surface of the occipital and temporal lobes, and begins somewhat laterally from the hinder point of the former. In its course forward it separates the *gyrus hippocampi* and the *gyrus occipito-temporalis medialis* (T_5), which lie on its median side, from the *gyrus occipito-temporalis lateralis* (T_4), which bounds it externally. Its extent forward is very various: sometimes it reaches to the anterior extremity of the temporal lobe, and thus surrounds the *gyrus hippocampi* very completely (see Fig. 3, right side of the figure); sometimes it ceases in the neighborhood of the end of the *gyrus fornicatus* (des Hakens), or is interrupted by a secondary bridging convolution.

This fissure is generally deep, and, as it appears, sometimes so deep that the wall of the lateral ventricle externally to the *cornu ammonis* is pushed inward thereby. It is called *fissura collateralis* by Huxley.

because in the interior of the lateral ventricle its relation to the *eminentia lateralis* s. *collateralis Meckelii* is similar to that borne by the *fissura calcarina* to the *calcar avis*, and the *fissura hippocampi* to the *cornu ammonis*, that is, it forms an incurvation which appears in the interior as a prominence.¹

CONVOLUTIONS.

The formation of the convolutions is, of course, entirely dependent on the development of the fissures; and in the region of the temporal lobe, in which the latter are most variable, the convolutions are so too. We distinguish:

1. *Gyrus temporalis superior* (HUSCHKE) seu *infra-marginalis*, upper temporal convolution (T_1).

SYN.—Gyrus temporalis primus, erste obere Schläfenwindung. WAGNER.

Antero-temporal gyrus. HUXLEY.

Pli temporal supérieur s. pli marginal postérieur (inférieur). GRATIOLET.

This very constant convolution lies between the *fissura Sylvii* and the *sulcus temporalis superior*,

¹ The name *fissura collateralis*, although it has the advantage of brevity, seems to me unadvisable, for the reason that the *eminentia collateralis*, from which it is formed, is by no means a constantly-present formation in the human brain (compare Jung on the lateral projection in the lateral ventricle of the human brain, Basle, and Arnold, *Anatomie*, I., 2, 769), while the *fissura collateralis* (Huxley) belongs among the typical never-wanting fissures.

and, arching around the upper end of the *fossa Sylvii*, passes into the *lobulus supramarginalis*.

2. *Gyrus temporalis medius*, middle temporal convolution (T_2).

SYN.—Gyrus temporalis secundus, zweite oder mittlere Schläfenwindung. WAGNER.

Mittlere Schläfenwindung. HUSCHKE.

Pli temporal moyen, and partie descendante du pli courbe.

GRATIOLET.

Medio-temporal gyrus. HUXLEY.

This convolution is most clearly marked off above toward the first temporal convolution, since the upper temporal fissure is almost never wanting, and it is also quite well separated behind and above by its passage into the *gyrus angularis*. Below, on the other hand, it is by no means invariably set off in its whole length from the third convolution, but frequently coalesces with it in a greater or less extent.

3. *Gyrus temporalis inferior*, lower temporal convolution (T_3).

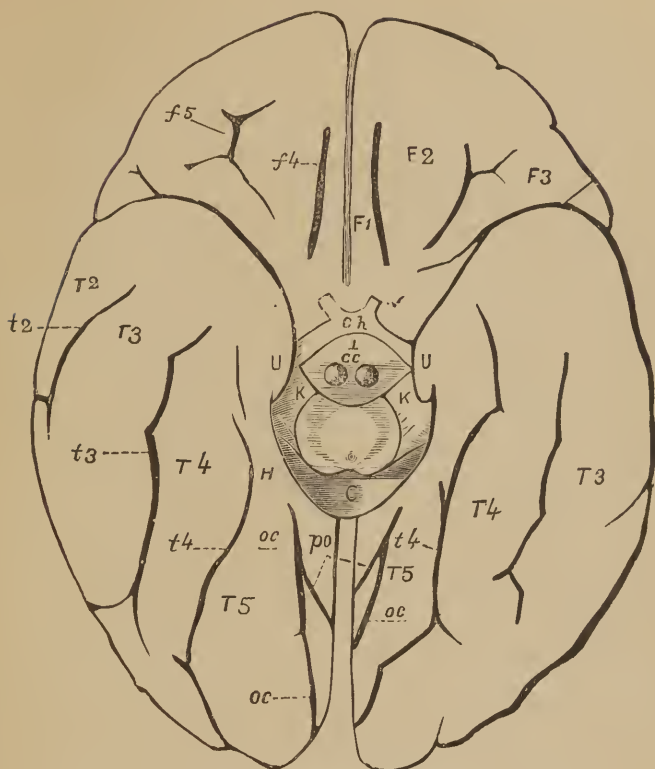
SYN.—Gyrus temp. tertius s. inferior, dritte oder untere Schläfenappenwindung. R. WAGNER.

II. ON THE UNDER SURFACE.

Gyri occipito-temporales (Fig. 3).

The lower surface of the hemisphere, so far as it is situated behind the *fossa Sylvii*, belongs partly to the *lobus occipitalis*, and partly to the *lobus tempo-*

FIG. 3.



VIEW OF THE BRAIN FROM BELOW.

*F*₁ Gyrus rectus, *F*₂ middle, *F*₃ lower frontal convolution.

*f*₄ Sulcus olfactorius, *f*₅ sulcus orbitalis.

*T*₂ Second, or middle, *T*₃ third, or lower temporal convolution; *T*₄ gyrus occipito-temporalis lateralis (lobulus fusiformis), *T*₅ gyrus occipito-temporalis medialis (lobulus lingualis).

*t*₁ Sulcus occipito-temporalis inferior, *t*₃ lower, *t*₂ middle temporal fissure.

po Fissura parieto-occipitalis.

oc Fissura calcarina.

H Gyrus hippocampi; *U* gyrus uncinatus.

Ch Chiasma nervorum optitorum; *cc* corpora candicantia (albicantia); *KK* pedunculi cerebri; *C* corpus callosum.

ralis, which here pass into each other without distinct boundaries, and it is within the territory of the former, so far as it rests on the *tentorium*, slightly concave; in the latter, in the middle fossa of the skull, convex. There is here seen a deep and constant fissure, the above-described *sulcus occipito-temporalis inferior*. It separates from each other two series of convolutions, the *gyri occipito-temporales*, which we distinguish as—

4. *Gyrus occipito-temporalis medialis* (PANSCH).
Lingual lobule (*T*₅).

SYN.—Lobulus lingualis, Zungenläppchen. HUSCHKE.

Untere innere Hinterhauptwindungsgruppe (No. 17). BIRSCHOFF.

This convolution is bounded externally by the before-mentioned *sulcus occipito-temporalis inferior* (*t*₄), and internally by the *fissura calcarina* (*oc*), and has rather a club- or leaf-shaped figure. The narrow part—handle—arises from the *gyrus hippocampi* beneath the *splenium corporis callosi*; thence it grows wider as it goes backward, but near the extreme point of the hemisphere regularly narrows again. This posterior narrow end is connected with the extremity of the posterior lobe, and especially with the convolution described above as *gyrus descendens*, which, arching around the posterior branch of the *fissura calcarina*, puts the convolutions of the

upper surface of the *lobus occipitalis* in connection with those of the lower.

5. *Gyrus occipito-temporalis lateralis*. (PANSCH.)
Fusiform lobule (T_4).

SYN.—Lobulus fusiformis, spindelförmiges Lättchen. HUSCHKE.

Unterer äusserer Hinterhauptwindungszug (No. 18). BISCHOFF.

This convolution is always clearly bounded on the median side by the *sulcus occipito-temporalis inferior*; laterally, the third temporal fissure, *sulcus temporalis inferior*, forms its boundary toward the lower temporal convolution. But, since this fissure is frequently wanting or incomplete, the lateral boundary of this convolution is by no means always alike distinct. It is of very various form, generally wider in the middle, somewhat narrowed anteriorly and posteriorly, and is connected with the convolution described just above, as well as with the *gyrus descendens*.

There have been, in all, five temporal convolutions described in the foregoing. But, as already mentioned, they are by no means all at once or uniformly developed; and, in order to see one's way clearly, it is convenient, following the advice of Bischoff, first to fix the eye upon those convolutions

which are subject to the least variation, in order to see the others from this starting-point. The most constant are : 1. On the lateral upper surface of the temporal lobe, the *gyrus temporalis superior* s. *infra-marginalis*, which appears almost always distinctly bounded by the fissure of Sylvius and the upper temporal fissure. So, also, 2. On the lower surface and on the median border of the temporal lobe, the lingual lobule and the *gyrus hippocampi* are always plainly to be distinguished, being bounded internally by the *fissura hippocampi* (*h*), and externally by the *fissura temporo-occipitalis inferior*. As to what remains between this last-named fissure on the one side, and the *fissura temporalis superior* on the other, it is very variously developed. Sometimes in this space there are two fissures distinguishable, more or less parallel with the above named, by which three convolutions are marked off; at other times only one fissure is to be recognized, and, of course, only two convolutions.¹ There may then be distinguished, on the occipital as well as on the temporal lobe, five convolutions running antero-posteriorly. Two of them, the *gyri occipito-temporales*, belong to both lobes in common, and hence each of these lobes has only three convolutions of its own, running in the direction in-

¹ On this subject see especially my figures of the brain from the eight and nine months' fœtus in the *Archiv für Anthropologie*, Bd. III., Heft 3.

licated; and of these only one in each lobe, namely, the *gyrus occipitalis primus* and *gyrus temporalis superior*, are entirely independent, while the second and third of each group pass directly or indirectly into each other.

E. MEDIAL SURFACE OF THE FRONTAL, PARIETAL, AND OCCIPITAL LOBES.

After the frontal, parietal, and occipital lobes have been separately considered, it is necessary to throw another glance upon the medial surface, the fissures and convolutions of which extend over several of the lobes mentioned, and hence must be considered in common.

FISSURES AND CONVOLUTIONS.

1. *Sulcus calloso-marginalis* (*cm*), fissure of the *corpus callosum*. HUXLEY, BISCHOFF, TURNER, MARSHALL, etc.

SYN.—Grand sillon du lobe fronto-pariétal. GRATIOLET.

Sulcus fronto-parietalis internus. PANSCH.

This fissure is of so definite formation, that it was clearly recognized and represented, as, for instance, by Vicq d'Azyr, at a time when but very little attention was given to the other convolutions. In the fetus it appears early.

This fissure takes its origin beneath the anterior extremity (*genu*) of the *corpus callosum*, passes upward around the *genu*, separated from the *corpus callosum* by the *gyrus fornicatus*, and runs backward about midway between the upper surface of the *corpus callosum* and the upper border of the hemisphere; at first it runs parallel with the surface mentioned, but a short distance before reaching the posterior extremity (*splenium*) of the *corpus callosum* it turns upward, and ends at the upper medial border of the hemisphere. The indentation of the medial border with which it ends may generally be recognized on looking at the brain from above. It is found immediately behind the medial end of the posterior central convolution (*cm*, Fig. 2). From the place at which the fissure begins to turn upward there is frequently, following the original direction, a slight prolongation backward of the fissure upon the quadrilateral surface of the præcuneus. Little secondary fissures pass, during its whole course, from the fissure downward into the *gyrus fornicatus*, as well as upward into the marginal convolution. Not unfrequently the fissure is bridged over in places by convolutions which put the two series of gyri separated by it into connection with each other.

2. *Gyrus fornicatus* (ARNOLD) (*Gf*), convolution of the *corpus callosum* (*Bogenwulst*).

SYN.—Processo enteroideo cristato. ROLANDO (l. c., S. 33, Taf. IIa).

Circonvolution de l'ourlet. FOVILLE.

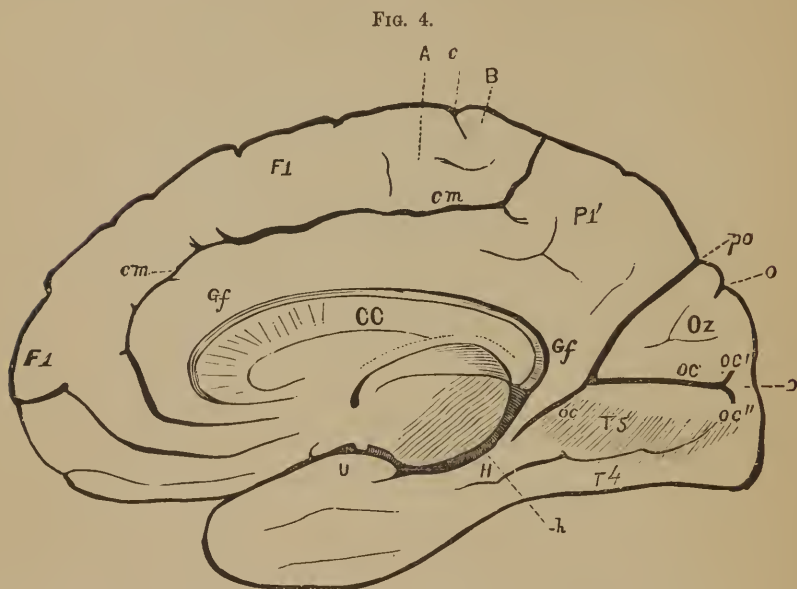
Zwinge, cingula oder gyrus cinguli. BURDACH.

Callosal gyrus. HUXLEY.

Fornix periphericus, äusseres Gewölbe. ARNOLD.

By this name is designated the curved system of convolutions surrounding the *corpus callosum*, which begins beneath the anterior extremity (*genu*) of the *corpus callosum* in the form of a narrow *gyrus*, bends around the *genu* to the upper surface, gradually increasing in size, passes backward, and, having arrived at the posterior extremity of the *corpus callosum*, turns around this (*splenium*) downward to the temporal lobe, along the medial border of which it continues as the *gyrus hippocampi*. The narrow convolution, with which the *gyri fornicatus* begins, arises below the point of the *genu corporis callosi*, and below the *septum pellucidum*, and is here connected with the *septum*, the inner root of the olfactory nerve, and with the *gyrus rectus*. Then the convolution, becoming broader in its passage forward, divides into two—the anterior rises and unites with the medial portion of the upper frontal convolution (*pli de la zone externe*, Gratiolet), while the posterior is the *gyrus fornicatus*. Before this is continued into the *gyrus hippocampi*, it enters into several other connections. First of all, it rises posteriorly, and coalesces with the *præcuneus* (P_1') the base of which rests

upon it in its whole length; then (directly behind the posterior extremity of the *corpus callosum*) a



VIEW OF THE MEDIAL SURFACE OF THE RIGHT HEMISPHERE.

CC Corpus callosum, cut through in the middle.

Gf Gyrus fornicatus, *H* gyrus hippocampi, *h* sulcus hippocampi, *U* gyrus uncinatus.

cm Sulcus callosomarginalis, *F*₁ first frontal convolution, its medial side, *e* end of sulcus centralis, *A* anterior, *B* posterior central convolution.

*P*₁' Præcuneus.

Oz Cuneus, *po* fissura parieto-occipitalis, *o* sulcus occipitalis transversus, *oc* fissura calcarina, *oc'* upper, *oc''* lower branch. *D* Gyrus descendens.

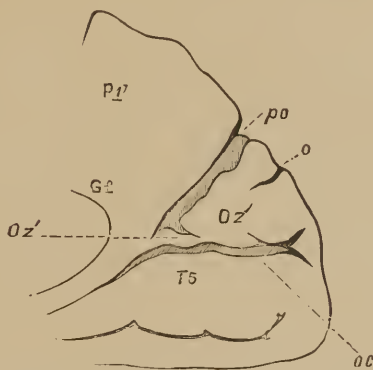
*T*₄ Gyrus occipito-temporalis lateralis (lobulus fusiformis).

*T*₅ Gyrus occipito-temporalis medialis (lobulus lingualis).

small convolution (*Oz'*, Fig. 6) arises from the *gyrus fornicatus*, which, previously sinking below the sur-

face, is connected with the apex of the cuneus (*Oz*). I will call it *gyrus cunei*.¹

FIG. 6.



VIEW OF THE POSTERIOR EXTREMITY OF THE RIGHT HEMISPHERE FROM THE MEDIAL SURFACE.

P præcuneus; *Oz* cuneus; *po* fissura parieto-occipitalis; *o* sulcus occipitalis transversus; *Gf* gyrus fornicatus; *Oz'* convolution of the cuneus; *oc* fissura calcarina; *Ts* gyrus occipito-temporalis medialis (lobulus lingualis).

Lastly, the *gyrus fornicatus* coalesces with the anterior extremity of the lingual lobule, *gyrus occipi-*

¹ Bischoff (l. c., S. 47) names this convolution the lower or fifth parietal convolution (No. 15), and correctly considers it as the analogue of the lower inner transition convolution (*pli de passage*) of the apex. As above mentioned, Gratiolet describes two inner (that is, situated on the medial surface) transition convolutions, which pass from the præcuneus to the cuneus, and distinguishes them as inner upper and inner lower transition convolution (*plis de passage interne supérieur et inférieur*). As to the first, the upper inner transition convolution, I make use of this opportunity to express my views upon this also.

Bischoff (l. c., S. 79) is of the opinion that this convolution is ho-

to-temporalis medialis, and then continues as the *gyrus hippocampi*. Thus there pass successively into the *gyrus fornicatus*: 1. The præcuneus; 2. The cuneus; 3. The lingual lobule. On the lower and media ledge of this convolution, lying upon the *corpus callosum*, a layer of white medullary substance is developed, which covers its gray cortex (*stria longitudinalis* s. *tecta*), and, spreading more widely as it passes backward and downward, covers the surface of the *gyrus hippocampi* as *substantia alba reticularis*.

3. *Gyrus hippocampi*. BURDACH (*H*).

SYN.—Subiculum cornu ammonis. BURDACH.

Circonvolution à crochet. VICQ D'AZYR.

Pli unciforme s. temporal moyen interne et lobule de l'hippocampe. GRATIOLET.

Uncinate gyrus. HUXLEY.

This convolution lies on the lower medial border of the temporal lobe, which embraces the *pedunculi*

mologous with the first outer transition convolution of Gratiolet (our *gyrus occipitalis primus*, *O*₁), and hence is wanting where the latter is developed, and *vice versa*. I regret to be obliged to oppose this view: not only do we find, as I will more particularly describe in another place, in the brain of various apes (*Cercopithecus*, *Cynocephalus*, etc.) both convolutions most clearly developed together, but we also not infrequently find in man a convolution which arises at the posterior extremity of the *præcuneus* with the *gyrus occipitalis primus*, runs backward in an arch convex inward and downward, while the former (*gyrus occipitalis primus*, as is known, makes an arch outward. In the cuneus the two convolutions again coalesce. This convolution is regularly sunk into the depths of the *fissura parieto-occipitalis*, and only becomes visible on pulling apart the borders of this fissure; but sometimes it also comes to the surface, and causes then a very unusual appearance of this part of the cerebral surface.

cerebri. It is bounded externally by the anterior part of the *fissura occipito-temporalis inferior*, internally by the *fissura hippocampi*, and may be considered as the common prolongation of the *gyrus fornicatus*, the convolution of the cuneus, and of the lingual lobule. After the *gyrus hippocampi* has been formed by these three constituents below the posterior end of the *corpus callosum*, it runs to the point of the temporal lobe, where it ends at the beginning of the transverse part of the *fissura Sylvii*, behind the *substantia perforata lateralis*, with a hook-shaped turn, the *uncus gyri fornicati* or *gyrus uncinatus*, *U*.

4. *Fissura hippocampi* (*h*).

SYN.—Anterior part of the “scissure des hippocampes.” GRATIOLET.
Dentate sulcus. HUXLEY.

The inner surface of the cerebral cavities is in immediate connection with the peripheral surface of the brain by a large cleft (*rima transversa cerebri*, Burdach). This cleft consists of a middle and two lateral portions.

The middle part of the cleft extends transversely between the *corpus callosum* and *corpora quadrigemina*, is bounded above by the first, below by the second and the pineal gland, and leads into the third ventricle. The lateral portion extends thence in a curve outward, downward, and forward, on the inner side of the lower lobe, between the inner portion of the

roof, and the floor of the lower horn, and leads into the *cornu descendens*. This fissure is thus bounded externally by the concave border of the *gyrus hippocampi*. If this border is somewhat lifted, a *sulcus* will be seen which runs along the border, and in which lies a gray cord. This *sulcus* stands in a relation to the *cornu ammonis* precisely similar to that of the *fissura calcarina* to the *calcar avis*—that is, the sulcus pushes the wall of the descending *cornu* inward toward the cavity, and thereby produces on the lower wall of the *cornu* the elevation just named, which is found in that place. The fissure is thence named *sulcus* or *fissura hippocampi*.

5. *Gyrus dentatus* s. *fascia dentata*.

SYN.—Dentate gyrus. HUXLEY.

Corps godronné. GRATIOLET and others.

The *cornu ammonis* represents a convolution pressed in toward the cavity of the lower horn of the ventricle. As the convolutions in general have, upon a transverse section, as Meynert correctly remarks, the form of a U—that is, of an inverted Ω , the convexity of which looks toward the surface—and the fissures that of an upright U, here such a U of the latter kind juts into the cavity of the descending *cornu* as an embossed projection, and forms the elevation of the *cornu ammonis*. The cavity of the U, however, is not empty, but filled mostly with

gray substance, and in the deepest portion with a prolongation of the *substantia alba reticularis*. Above all lies a frequently-contracted cord of gray substance, the *fascia dentata* or the *gyrus dentatus*. This little gray convolution begins behind the *splenium corporis callosi* on the medial surface of the *gyrus fornicatus*, as the *fasciola cinerea*, then descends along the *cornu ammonis*, covered by the *fimbria* or *tenia*, and finally ends with the so-called *cauda* on the lower surface of the *gyrus uncinatus*.

There is hardly a point in which the brain of most apes is so essentially distinguished from that of man as in regard to the just-mentioned *fissura hippocampi*. In man, as we have seen, the *gyrus fornicatus* passes without interruption into the *gyrus hippocampi*, and thus the *fissura calcarina* and *fissura hippocampi* are separated from each other by this continuous series of convolutions. In the apes, on the contrary—so far as known, with the single exceptions of *Ateles* and *Hylobates*—the two just-named fissures pass immediately into each other, and thence in them the *gyrus fornicatus* and *gyrus hippocampi* are separated from each other. Hence, Gratiolet, who derived his whole terminology from the ape's brain, described the two fissures which we

separate as *fissura calcarina* and *fissura hippocampi* as one, the *scissure des hippocampes*.

F. INSULAR LOBE.

Island. REIL.

SYN.—Stammlappen, lobus caudicis. BURDACH.

Zwischenlappen oder verstecker Lappen, lobus intermedius s. opertus. ARNOLD.

This lobe lies concealed between the frontal, parietal, and temporal lobes, and especially overhung by the *operculum*, so that it is only seen after opening out the *fissura Sylvii*, and is surrounded by a furrow. Its surface is furnished with short convolutions (*gyri breves*, Gall), which diverge from a point on the lower side, forward, upward, and backward, and have the form of a slightly-curved hook.

APPENDIX.

ACTING upon the conviction expressed in the preface, that it is especially the task of physicians to furnish the materials for a future organology of the brain, I do not consider it superfluous to add something upon the methods of examination and the recording of observations.

In order to find one's way in the apparent chaos of convolutions, it is best to start from the principal fissures. After the *pia mater* has been as much as possible removed¹ from the brain taken out of the skull, the *fissura Sylvii* (*S*) is sought for, and its two branches, the posterior horizontal (*S'*) and the anterior ascending (*S''*). Starting from the operculum, which projects between these two branches, we seek for the *sulcus centralis* (*c*) and the two central

¹ This is best done under water, but the stay of the brain in water must be but a short one, as it otherwise becomes too soft by imbibition.

convolutions which border it, the anterior (A) and the posterior (B). Going from the anterior (A) we follow the frontal convolutions, F_1 , F_2 , F_3 , of which the lowest, F_3 , curves around the anterior ascending branch of the *fossa Sylvii*. On the portion of the cerebral surface which lies behind the central fissure (parietal and occipital lobes), the *fissura parieto-occipitalis* is sought for, cutting in from the medial border. This is always easy to find, if one starts from the medial surface. It bounds, on the surface, the easily-recognizable cuneus (Oz) anteriorly, and separates the parietal from the occipital lobe. The external extremity of the fissure named is surrounded by an arched convolution, which I have designated *gyrus occipitalis primus*. If we follow forward the fissure (ip) which bounds the convolution externally, we find that, although sometimes bridged over, it runs outward and forward, and divides the parietal lobe into two portions. This fissure is the *sulcus interparietalis*, and the two divisions of the parietal lobe are the upper (P_1) and lower (P_2) parietal lobules. The latter consists of an anterior group of convolutions (*gyrus supramarginalis*, P_2), which curves around the upper extremity of the *fissura Sylvii*, into the upper temporal convolution, and of a posterior (*gyrus angularis*, P_2') which curves around the upper temporal fissure (t_1), and passes

into the second temporal convolution. On the temporal lobe, situated below the horizontal branch of the fissure of Sylvius, it is easy to recognize the upper temporal convolution (T_1) and the upper temporal fissure (t_1); for the remaining portion of the temporal, as well as of the occipital lobe, I must refer to the previous description. If a median section has been made through the *corpus callosum*, and the two halves of the brain separated, we now see the fissures and convolutions of the medial and lower surfaces in connection. First of all, we trace the *gyrus fornicatus* (Gf), embracing the whole *corpus callosum*, which is then immediately continued into the *gyrus hippocampi* (H), and ends with the *gyrus uncinatus* at the anterior lower and internal extremity of the temporal lobe. With the *gyrus fornicatus* are connected: 1. The præcuneus (P_1); 2. The cuneus (Oz); 3. The lingual lobule (T_5).

The great difficulty of an accurate description makes it seem advisable always to make a sketch of the portion of the cerebral surface where altered convolutions are met with. For this purpose may be recommended, as well for the sake of accuracy as of easy execution, geometric drawing, with the diop-ter of Lucæ, for the management of which I will especially refer to the communication of Landzert, in the "Archiv für Anthropologie" (Bd. II., S. 1).

For preserving the brain, if one does not wish to make a more careful examination immediately after the section, or wishes to keep the preparation, the chloride of zinc advised by Gratiolet and Bischoff is especially to be recommended, for the reason that there is no need of removing the *pia mater* before the brain is placed in this fluid, since after it has been some time therein it is even more easily separable than in the fresh condition. If it is desired to use alcohol for the hardening, the previous removal of the *pia mater* is absolutely necessary; this may be very well done under water, if the brain is placed in absolute alcohol immediately afterward. Brains hardened in chloride of zinc must also, after some time, be kept in alcohol. For completely retaining the form of the brain, the injection of alcohol or chloride of zinc into the carotids is very advantageous; but, in using the former fluid, the subsequent study of the convolutions is subject to some difficulties on account of the firmly adherent *pia mater*.

Finally, I will mention that Dr. Ad. Ziegler, in Freiburg, has undertaken to make a wax model of the human cerebral convolutions according to my designs, which may soon be obtained from him.

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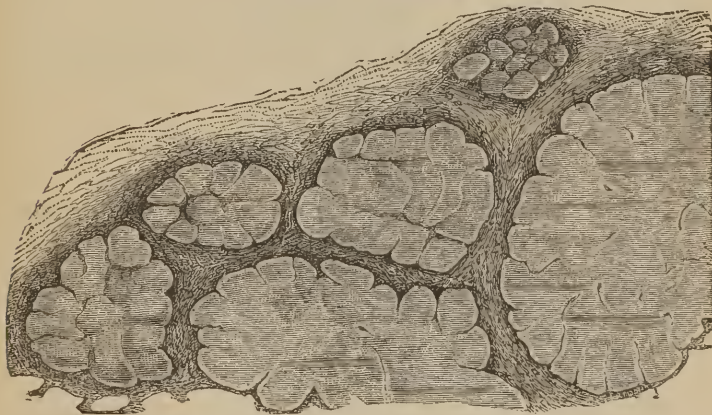
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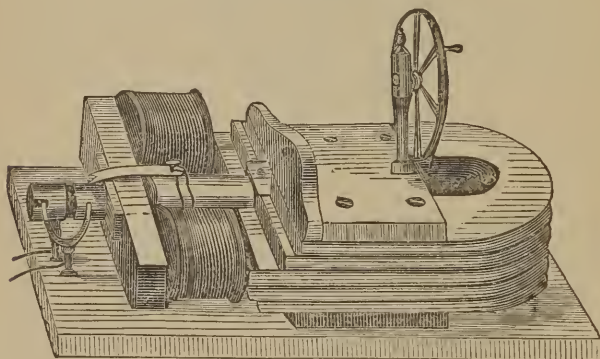
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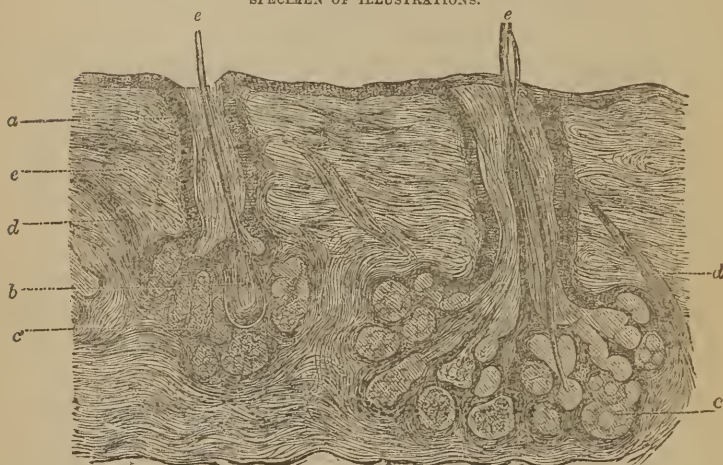
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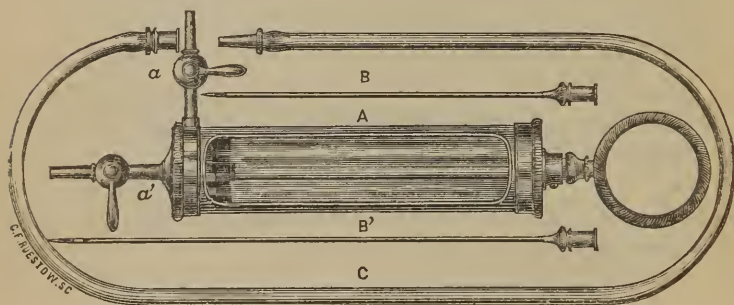
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